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ENVIRONMENTAL TRENDS IN THE GULF OF MAINE

HEARING

BEFORE THE

SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

OF THE

COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

FIRST SESSION

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CONTENTS

Page

Mitchell, Hon. George J., U.S. Senator from the State of Maine, opening statement of 1

WITNESSES

Blackmore, Edward, president, Maine Lobstermen's Association 16
Brennan, William J., commissioner, Maine Department of Marine Resources 4
    Written statement 40
Curtis, Kenneth M., chairman, policy board, ARGO Maine 9
    Written statement 55
Ehler, Charles N., Director, Office of Oceanography and Marine Assessment, National Ocean Service, National Oceanic and Atmospheric Administration 25
    Written statement 78
Lick, Dale W., president, University of Maine 7
    Written statement 51
Johnson, Anne C., director of marine programs, Maine Audubon Society 23
    Written statement 70
Jordan, Thomas C., president, Maine Fishermen's Cooperative 17
Kaelin, Jeffrey, executive director, Maine Sardine Council 18
    Written statement 65
Yentsch, Charles S., chief executive officer, Bigelow Laboratory for Ocean Sciences 3
    Written statement 32
Statement submitted for the record: Anderson, Walter 94

ENVIRONMENTAL TRENDS IN THE GULF OF MAINE

TUESDAY, SEPTEMBER 8, 1987

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION,
Augusta, ME.

The subcommittee met, pursuant to notice, at 1:30 p.m., at Council Chambers, 389 Congress Street, Portland, Maine, Hon. George J. Mitchell (chairman of the subcommittee) presiding.

Present: Senator Mitchell.

OPENING STATEMENT OF HON. GEORGE J. MITCHELL, U.S. SENATOR FROM THE STATE OF MAINE

Senator MITCHELL. Good afternoon, ladies and gentlemen. I welcome you all to this hearing held by the Subcommittee on Environmental Protection of the Senate Committee on Environment and Public Works. Today's hearing will focus on environmental trends in the Gulf of Maine and the need for greater scientific research and monitoring in the gulf.

The Gulf of Maine is a resource of tremendous value to our State, both in economic terms, and as a rich, natural ecosystem. It is vitally important for the State's fishing industry. In 1986 total fisheries landings in Maine were about 166 million pounds, valued at $108 million. Our coastal waters also provide a variety of recreational opportunities and play a role in commerce and other related industries.

We take great pride in the fact that the estuaries and coastal waters along Maine's 3,500 miles of coastline are still very clean. We do not face the environmental problems which plague coastal waters such as Chesapeake Bay or Boston Harbor.

It is important that we maintain the quality of our unique resource. We must be alert to recognize potential threats and be ready to prevent problems before they occur.

Several recent scientific reports have identified some pollution at specific sites in the Gulf of Maine. In a study released this past spring, the National Oceanic and Atmospheric Administration reported that sediments tested from the bottom of Casco Bay had the fourth highest level measured in the Nation for polycyclic aromatic hydrocarbons, a known carcinogen.

Studies in 1982 by the Bigelow Laboratory in Boothbay Harbor and NOAA showed significant levels of trace metals and polycyclic aromatic hydrocarbons in sediment samples for Penobscot Bay.

Sampling data from 1983 also documented polychlorinated byphynols, or PCBs, in the deeper regions of the Gulf of Maine.

Although these few examples are not evidence of a general pollution problem, they point to potential long-term risks which warrant our attention.

In addition, the Gulf of Maine may face increasing pressures in the future.

The prospect of offshore oil exploration has been renewed, with the proposed sale of leases for exploration of 5.5 million acres of the outer continental shelf off New England by February of 1989.

Coastal development and the associated impact of sewage discharges and stormwater runoff may increase. There is concern about loss of critical fisheries habitat. A large percentage of fish species caught in the gulf depend on coastal marshes and estuaries for part of their life cycle.

Sea level rise from the warming of the Earth from the greenhouse effect may in the long term change the gulf's circulation patterns and inundate some valuable wetlands. Major construction projects, such as tidal power in the upper part of the gulf, are under consideration. Even air pollution, which has been suggested by some researchers as a source of the hydrocarbons found in Casco Bay, may have an effect on the gulf.

On the national level there is growing concern about the health of the Nation's estuaries and near-coastal waters. A major study by the congressional Office of Technology Assessment concluded that the overall health of our Nation's coastal waters is declining or threatened.

The Subcommittee on Environmental Protection, which I chair, shares jurisdiction for marine research with the Senate Committee on Commerce under title II of the Marine Protection Research and Sanctuaries Act.

The subcommittee also has jurisdiction over the Clean Water Act, which addresses water quality in estuaries and coastal waters. Information we now have both nationally and in this region is sufficient to warrant the subcommittee's attention.

However, I want to make clear our present knowledge and intention. The Gulf of Maine is very clean. It is our responsibility to protect the gulf and make sure that it stays clean. To prevent problems before they occur, a first-rate scientific research and monitoring program is needed.

I hope this hearing will give us a clear and accurate picture of environmental trends in the Gulf of Maine. In addition, I look forward to hearing the views of the witnesses on what we should be doing to preserve the high quality of the gulf: Should we expand scientific research and monitoring? What priority should be given to different types of research? Is there a need for greater cooperation, coordination, expanded technical effort, or more stable funding sources? And what is the appropriate role for the Federal Government to play in research and monitoring in the gulf?

We are fortunate to have extremely qualified witnesses from around the State to address this important issue. The first panel includes representatives of the scientific and educational community who have organized the Association for Research in the Gulf of Maine. ARGO Maine, as it is called, has begun to provide important leadership and direction in coordinating Maine's scientific research.

It was my recent privilege, along with the rest of the Maine congressional delegation, to assist ARGO Maine in acquiring from the National Science Foundation an 80-foot ocean research vessel which will become the flagship for much of their research program.

The second panel represents Maine's vital fishing industry.

Our final panel includes representatives of the appropriate Federal agencies and the environmental community.

I want to thank everyone for coming this afternoon, and we will now hear from the first panel of witnesses. I will ask them please to come forward: Mr. Curtis, Commissioner Brennan, Dr. Lick, and Dr. Yentsch.

I understand you have decided among yourselves in what order to proceed. Therefore, we will begin with Dr. Charles Yentsch, chief executive officer, Bigelow Laboratory for Ocean Sciences, in West Boothbay Harbor.

I want to say, Dr. Yentsch, before you begin, for the benefit of the other witnesses and the members of the public, all written statements will be placed in the official record of the Senate subcommittee hearing. I have asked each witness to summarize their remarks in approximately five minutes so that we can hear from all the witnesses and have some chance for exchange of views among the witnesses and response to questions.

Dr. Yentsch, welcome. We look forward to hearing from you.

STATEMENT OF CHARLES S. YENTSCH, CHIEF EXECUTIVE OFFICER, BIGELOW LABORATORY FOR OCEAN SCIENCES, WEST BOOTHBAY HARBOR, ME

Mr. Yentsch. Thank you very much, Senator Mitchell.

I think that with your experience in environmental affairs you will recognize that environmental problems come about as a reactionary consequence to certain catastrophes and that some of the cases that you have pointed out—Chesapeake Bay, New York Harbor, Boston Harbor—are cases in mind.

I consider my role here today to be to stand and voice a concern and express an early alarm of the conditions that exist in the Gulf of Maine and what conditions that we can have occur if processes are allowed to go on that are unregulated, unrecognized, and uncontrolled.

The major theme of what I am to tell you is that for a modest investment in research, we can essentially produce a program that will allow for long-term prevention of major catastrophes and essentially a sensible design for the utilization of the resources in the Gulf of Maine.

The signs are all out there. You pointed them out in your opening statement: sea level rise, population growth along the coast, red tide outbreaks, drastic changes in fish abundance, toxic metals, acid rain, acid fogs, and so forth.

It is also clear that people who want to utilize the resources along the Gulf of Maine are on head-on collisions as far as the use. Those who wish, say, to farm for fisheries are essentially competing with those who want the pristine nature of the water for recreation, and so forth.

The present status of the research that is ongoing is on an ad hoc basis. Single-investigator research is a characteristic of our laboratory. We have people who are looking at essentially oceanographic features that concentrate on fishes, and we have people who are looking at satellite images and so forth to try to essentially explain some of the phenomena that we see in the Gulf of Maine.

What is really needed is a whole ecosystem effort. That sounds like a complicated topic. In essence, what I am saying is that we need to look at all of the parts together so that we can make some sense of that sum. When you do this with the modern techniques that exist in the ocean sciences, we have numerical models that we can apply to those, and we can eventually essentially put that information back into a management scheme that will allow the regulating agencies a sensible assessment of the problems.

For your specific interest, in my testimony I enclose a figure of satellite image that shows, in essence, some of the problem. As you well remember, I contacted you with regard to the acid rain/acid fog problem. This is a satellite image taken some 500 miles from Earth that shows a large bloom of microorganisms that exists. They reflect sunlight. These organisms have the potential of producing acid, Senator, and these acids get into the atmosphere and aggravate the problem of acid rain.

Now, the important aspect of this particular organism is accentuated by man's activities. The addition to fertilizers and so forth cause this specific organism to grow. We call these "low smokestacks in the sea," and our laboratory is in the forefront in trying to understand the causative factors.

I should close by saying that we have plenty of talent within the State and no longer have to go to Massachusetts, California, or wherever to get the talent. ARGO Maine has accrued essentially the competent ocean scientists in the State from universities or private laboratories like ourselves or the Department of Marine Resources, the State agency.

We know the scenario if we don't do something. It is like an old film in which you know the ending. You have already pointed out that these other areas wind up with catastrophic situations in which people are penalized and monies are utilized to clean up.

What we want to do is clip this film and put in it a scenario that essentially leads to sensible regulation based on real science and environmental sense. Thank you very much.

Senator Mitchell. Thank you very much, Dr. Yentsch.

Our next witness will be Mr. William J. Brennan, commissioner of the Maine Department of Marine Resources.

Welcome, Commissioner Brennan. It is good to see you again.

STATEMENT OF WILLIAM J. BRENNAN, COMMISSIONER, MAINE DEPARTMENT OF MARINE RESOURCES

Mr. Brennan. Thank you, Mr. Chairman. I am pleased to appear before you today to present my perspectives on the environmental trends and the need for further scientific research and monitoring in the Gulf of Maine.

The Department of Marine Resources engages as the single primary instrument of the State in all aspects of marine resource research, development, management, and enforcement. In this, we are perhaps unique, at least on the Atlantic coast.

Because of our far-reaching mandates, we have a unique, comprehensive perspective on issues pertaining to our marine resources—not a thorough understanding, but rather one which in many respects reflects only the understanding that there is a multitude of influences on those resources. It is, in fact, that lack of a thorough understanding that brings us all to this hearing today.

Our multifaceted mission raises research, management, public health, and enforcement responsibilities to the forefront. I would like to briefly characterize the role in these areas.

Our research focuses on those things relevant to understanding the species of importance to the State's fisheries. I have provided for the record copies of the department's 1986 annual research report, which will afford the committee with an overview of this agency's most recent research agenda.

The major purpose for which we undertake marine fisheries research is our responsibility for resource management. Such management systems must be based on the best scientific information available. However, in many fisheries, and certainly with respect to the resource and habitat as a whole, we are operating with only superficial knowledge. This is a major impediment to effective management.

The department undertakes management initiatives in three major areas: first, unilaterally, as the State's fisheries management agency for species under State jurisdiction; second, through management programs implemented by the Atlantic States Marine Fisheries Commission; and third, through participation in the New England Fisheries Management Council.

Just as State actions should be based on the best scientific information available, interjurisdictional fisheries management just have the same basis, a basis which is not always available.

Another major departmental responsibility is monitoring and protecting the public health. The highest priority in this area has involved close scrutiny of the coastal waters in the context of the State's vast and popular shellfish resources.

Beyond that focus, we have increasing interest in understanding the incidence and role of other possible contaminants of marine waters. Of interest is the possibility of a relationship between environmental conditions and fish pathology.

The final department mandate pertinent to this area is enforcement. Suffice it to say that given the complexity of fisheries management, various conservation programs, protection of public health, and, more simply, the large area which we must survey, our enforcement responsibility is a major undertaking.

My comments to this point have focused on what the State's marine resource agency does. I would like to focus now on the context in which those things are done: the Gulf of Maine, its coastal waters, and the lands and rivers which bound and feed it.

The Gulf of Maine, in 1986, yielded to Maine fisheries products totalling 166 million pounds valued at $108 million at the dock. Our sister States of New Hampshire and Massachusetts realized similar contributions to their economies. The true value of this production is several times the landed value and should not be underestimated in the context of both employment and food. It is the conviction of many that the gulf and coastal waters must be treated as a whole, much as any more easily definable body such as the Chesapeake and Narragansett Bays are.

The coastal rim of the Gulf of Maine if an area of intense manmade and natural activities. Population densities vary from 20,000 per square mile around Boston Harbor to an average of 184 per square mile or less along portions of Maine's coast. It is estimated that 75 percent of the U.S. population will live within 150 miles of the coast by the year 2000. Including the Boston Harbor basin, this crescent also contains at least ten major river watersheds draining major portions of New England.

The interaction of these human and natural elements have the potential to affect the Gulf of Maine ecosystem profoundly and immediately, as conflicts between them accelerate. The fact that the gulf has a unique integrity lends additional importance to the fact that the influence of estuarine and riverine systems have on the gulf must be considered as an important biological system of the gulf. In fact, the interplay between the lands bordering the gulf and the gulf itself is a dynamic for which we have only elemental understanding.

Let me characterize some of the indicators we are aware of with regard to environmental and ecologic concerns.

The first is fairly graphic, yet its full impacts are not clear. On April 1 of this year, Maine experienced very significant floods. As a direct reaction to that event, my department necessarily closed a major portion of the coast to harvesting of shellfish, given the risk of presence of bacterial contamination. That contamination is, in reality, only a physical representation of what are likely more profound impacts on the entire coastal ecosystem which impact or are impacting on the activity in several major fishing areas.

Other indicators of problems that come are reflected in the context of air pollution and acid rain. At the air-sea interface, contaminants in air mix with water vapor and rain into the ocean. The ecological effects are largely unstudied, but warnings are clear. For example, inorganic nitrogen precipitated into the surface waters and sun fertilizes the growth of phytoplankton and has been implicated as a cause of red tides and paralytic shellfish poisoning.

There is good evidence that air pollution is the major source of polycyclic aromatic hydrocarbons which occur in sediments in Penobscot and Casco Bays and in two deep basins offshore at concentrations typical of heavily industrialized areas.

The pH concentrations in sediments and shellfish are directly and strongly correlated. Terrestrial runoff is already a major concern for marine sport and commercial fisheries in Maine. Anadromous fish such as salmon, which use rivers to spawn, obviously are affected.

Less apparent, perhaps, but no less real may be the effects of acid water on marshes, estuaries, and nearshore habitat. Although little studied, alterations of processes in these areas could change the geographic distribution and productivity of clam flats and fishing areas.

The impacts of these forms of pollution on marine resources in the gulf cannot be separated from two important realities. First, knowledge of the short-term and long-term natural fluctuations in populations of organism is incomplete at best. Second, these forms of pollution perturbations interact among themselves and with natural sources of disturbance such as bacteria, viruses, and storm erosion, to cause resources to fluctuate in abundance and distribution.

These events do not, in our estimation, suggest that a crisis is forthcoming. Rather, they are by way of example only and are indicative of the need to further focus on the Gulf of Maine as a system. To address many of these concerns, the Department of Marine Resources has expanded its research activities beyond those bounds customarily thought of as the State's responsibility. The need to gain a fuller understanding has stretched our budgets and personnel capabilities to the limit. But at each juncture we find more questions than answers.

Expanding the marine research partnership throughout the region—drawing upon the expertise found within our State, Federal, private, and academic institutions—is the only means of ensuring effective and productive management decisions regarding our use of and effect on the Gulf of Maine.

It is these thoughts which have led the primary marine R&D institutions in Maine to create a consortium approach to focusing on issues.

Mr. Chairman, we are seeing pressure on a heretofore pristine gulf. The human population along the coast is growing at an astronomical rate. Likewise, the fisheries are increasing to the point of overharvesting an otherwise sustainable resource. Only research into the fundamental functioning of the gulf, with a clear mandate to relate this to fisheries production, will we as a human population be able to continue to reap the aesthetic pleasures of the fisheries resources of the Gulf of Maine.

The existence of this consortium serves as an outstanding paradigm. The coincidence of it and the resources it focuses on are an occurrence which should be encouraged and utilized. It is that message, Mr. Chairman, that I hope to leave with the subcommittee today.

Senator MITCHELL. Thank you very much, Mr. Brennan.

We will next hear from Dr. Dale Lick, the president of the University of Maine, at Orono.

Dr. Lick got the university football team off to a flying start on Saturday.

Sterner tests lie ahead, though, Dr. Lick.

It's good to see you again. We look forward to your testimony.

STATEMENT OF DALE W. LICK, PRESIDENT, UNIVERSITY OF MAINE, ORONO, ME

Dr. LICK. Thank you. It is a pleasure, Senator Mitchell, to have a chance to come and share with you and to outline the University of Maine's policy with regard to the Gulf of Maine.

The Gulf of Maine, often described as one of the five richest and most productive marine areas on the planet, serves as a prime example of Maine's complex and longstanding relationship to the ocean. It is an important focus of increased environmental concerns which must be balanced carefully with use of the increased economic bounty that the gulf represents.

In legislation as well as in prices of land and fish, we as a society are showing a rapidly increasing societal valuation of the ocean. What has not kept pace with this increasing valuation of the ocean and its sense of its promise has been our understanding of its workings.

Our society, in its better moments, believes in meeting complex problems by understanding their nature and then acting with that understanding in a rational manner. The university and other institutions represented here can provide the mechanisms and the people to generate an understanding of the Gulf of Maine in order to deal sensibly with the increasing pressures on it.

One responsibility of research institutions is to clarify the essential linkages between research results and the people who use those results. Each of the institutions providing you with testimony today has its own mechanisms for dissent or mediation. Let me provide you with explanations of a couple of the mechanisms utilized by the University of Maine.

Our Sea Grant program, one of 32 in the Nation, operated jointly with the University of New Hampshire, conducts a wide variety of research and outreach programs. The problems chosen for research attention as so chosen because of their relevance and timeliness. A tightly connected outreach program serves both to bring the results of this research to user groups throughout the region and to bring user group needs to the attention of scholars undertaking new research projects. This program has been highly effective in helping our region.

Another and more recent development is the Maine Lobster Institute, a cooperative venture of the University of Maine and the lobster industry. It serves to identify practical problems of concern to the industry and to define their solutions. The information generated is disseminated free in a variety of ways.

These are two examples of the ways in which the University of Maine carries out the research and public service aspects of its mandate as the Land-Grant University and the Sea-Grant College of the State of Maine. They are conducted with deep commitment, efficiency, and common sense.

But they are still not enough. New questions are arising from pressures such as shoreline development, tidal power, potential pollution problems, and changing international boundaries. These increasing pressures on the Gulf of Maine demand additional responses. We at Maine have explored those additional responses, and we are poised to act.

One major new mechanism for the university to expand its impact is ARGO Maine. While Governor Curtis will describe in greater detail the structure of this organization, let me add that ARGO Maine will allow us to increase the effectiveness of our participation in the Gulf of Maine research. The task clearly requires far more resources than any institution has available, and ARGO

Maine will aid in the research prioritization, coordination, and quality control that will be necessary to conduct any large-scale program successfully.

At the University of Maine we have recently made a major commitment to the expansion of our marine sciences program. We stand ready to shift considerable and scarce salary resources to the hiring of marine scientists who can help in this venture.

In particular, we have prioritized the hiring of five people who are oriented towards basic environmental processes in the Gulf of Maine. At the same time, we are expanding our marine field station, the Ira C. Darling Center. This facility provides us with an exposure and access to the water which will be critical in any future expansion of Gulf of Maine research.

In closing, our institution along with the others engaged in similar missions is increasingly prepared to serve our role in meeting the challenges in the Gulf of Maine. We have a large base of expertise to perform the research needed and the experience of tying this type of research to the needs of the community. We need only the resources to carry out the work in this rapidly changing region.

We appreciate the opportunity of sharing this with you. Thank you very much.

Senator MITCHELL. Thank you very much, Dr. Lick.

The final member of the panel is Kenneth Curtis, president of the policy board of ARGO Maine, and president of the Maine Maritime Academy, and, of course, as we all know, a distinguished former Governor, someone who has contributed so much to our State over the many years.

Governor, it is a real pleasure to welcome you here again. We look forward to hearing from you.

STATEMENT OF KENNETH M. CURTIS, CHAIRMAN, POLICY BOARD, ARGO MAINE; PRESIDENT, MAINE MARITIME ACADEMY, CASTINE, ME

Mr. CURTIS. Thank you very much, Mr. Chairman

Along with the statement which I have submitted for the record, we have included some appendices which have been prepared previously by ARGO which we hope will aid the subcommittee in providing some background information you might find useful.

First, I must succumb to the temptation, a very pleasant temptation, to commend you for your strong leadership in environmental protection throughout the country, and foremost here in our own State.

I think we all remember the contribution that Senator Muskie made as a national leader in environmental matters before these concerns were in vogue.

I was very pleased during my years as Governor to see Democrats and Republicans in the legislature, in the best example of bipartisanship, enact some of the strongest environmental legislation in the United States, much of which is still on the books.

So I think Maine takes great pride in its environmental leadership, and we applaud you, Senator, for your advancement of environmental concern again at a time when the outside observer might conclude that the environment is not the number one priority and issue that it once was.

I would just like to say that I think Maine has been negligent in one vital area of the environment, and this is the attention that it has given to its ocean resources. In relation to the State's historic devotion to its forests, activity in the ocean areas has really been minimal. The State of Maine is blessed with seemingly limitless natural resources—Maine's waters—that have for centuries been used as bountiful fisheries and helped fashion a way of life for which Maine is now famous.

But unfortunately, these natural resources are not limitless, and as has been plainly demonstrated in other parts of the coasts of the United States, they can be driven to the point of severe depletion and extermination.

Often, this realization seems to come too late, and the task then becomes one of recovery rather than preservation. As you have said, Senator, in your opening remarks, I think people forget the immense value that the Gulf of Maine has for the economy of New England and for the livelihood of its citizens. And perhaps it is even more critical for the State of Maine. What happens in the offshore waters of the Gulf of Maine impacts on virtually ever aspect of our coastline, all 3500 miles of it. Given our dependency on this vital resource, I think it's a great cause of alarm that we must admit that our present scientific understanding of the processes which control it remains at only a rudimentary level.

While to the outside observer the gulf as a whole may seem to stand out as a prime example of a pristine body of water, I think we must face reality that it is just as vulnerable as America's other coastal environments that today face enormous cleanup costs.

The health of the Gulf of Maine 10 years or 50 years from now need not mark those bodies of waters which have been subject to unchecked demographic stresses that have impacted other coastal waters in ways that scientists are now only beginning to understand.

As has been said, if the resiliency of the Gulf of Maine can withstand the impact of human activities thus far, it is by all outward appearances at least remarkable, and the continually exploitation of its natural resources have not yet seemed to pose a sufficient threat to the entire system to raise a crisis situation which we too often wait to occur before we get around to take action.

It is sort of ironic that while advances on many scientific fronts have been made in the last two decades, instead have only the crudest models for predicting the processes operating in coastal Maine ecosystems such as the Gulf of Maine. Yet, the last few years have witnessed an explosion of technology which facilitates the rapid acquisition and dissemination of an enormous amounts of debt.

We stand at the threshold in these exciting times of applying these modern technological marvels for all the Gulf of Maine from satellites which can observe oceanographic processes from space, to flow cytometers, which examine the properties of individual microscopic plankton cells at a rate of 20,000 per second.

But, in spite of all this technology, random applications of the Gulf ecosystem will not in and of itself guarantee success. Probably what is needed most of all is a planned, well-coordinated approach to the research effort.

Maine scientists and, most recently, the Main Maritime Academy, recognizing the need for such a coordinated research initiative, have joined in an association to form a critical mass of scientific and marine expertise, committed to studying and preserving the Gulf of Maine in a whole ecosystem approach.

I know that we all know that this is now known as ARGO, but I would like to repeat for the record, and for those here at this hearing here, the members, the distinguished members, who make up this consortium are the University of Maine, the Maine Department of Marine Resources, Bigelow Laboratory for Ocean Sciences, the Maine Geological Survey, and Main Maritime Academy.

The State of Maine itself has, in these institutions, a remarkable and large number of highly recognized scientists. At last review I think we have approximately 75 researchers that are available now to participate in this activity.

So by joining together as a group, this capability will, through ARGO, be channeled towards the Gulf of Maine in a manner that can have a maximum impact.

ARGO stands ready to mesh information from oceanographic and climatological observations with features of water chemistry and marine biology in an effort to understand the intricacies of the myriad factors ultimately controlling the health and well-being of the Gulf of Main, and I think can provide many answers to the problems of our nation's waters, in general. One or a few major research programs we see by an organized group of scientists will serve as the core effort to bring us more efficiently to a wholistic understanding to the Gulf of Maine as a model coastal ecosystem.

You've always said that Maine is small enough that it can become a laboratory. We do not have enough people yet to stumble over one another. We have just barely enough to get the job done. But it is a great deed that we could do here to provide answers for the entire coastal area of the United States.

Most importantly, Maine's awarding of the well-equipped research vessel by the National Science Foundation, to be operated by Maine Maritime Academy, solidifies the framework for research to move forward.

Again, on behalf of myself and ARGO, I want to express our sincere appreciation for you and members of the Maine Congressional delegation for all of their help in obtaining this research vessel. In spite of the rich Gulf of Maine resource, this is the first deep-sea research vessel to be stationed north of Cape Cod. Maine's strong cadre of scientists now have the capability to devote off-shore research activities on a year-round basis.

The ARGO-Maine initiative has already gained support from the Maine legislature in the form of operational monies for this newly acquired research vessel, but scientists will require additional assistance beyond the capabilities of the State if we are to undertake the wise management of our coastal resources.

So it is our believe that a research program on the order of a decade in length can provide answers to the questions alluded to above and detailed in other testimony. Resources from the Federal Government are clearly needed.

Other states with coastal waters have mounted ambitious programs for studying and protecting their ocean resources, often when it's already, perhaps, too late. Maine has been slow in recognizing the need to maintain and to protect the quality of the Gulf of Maine.

I hope we will have the wisdom to invest some of our resources to our preservation, but it would seem to me it's far more prudent to expend the lesser financial resources now to preserve this coastal resource, rather than that of following the sad course of other areas of expending far greater sums really after it's too late.

Senator **Mitchell**. Thank you very much, Governor, for, as usual, a very plausible and informative statement.

I want to thank all of you for your work in organizing ARGO-Maine. That's a major step forward for the Maine scientific community, and will no doubt improve marine research in the coming years.

I want to begin with a general question, which I'd ask each of you to respond to. Governor Curtis really has responded to it in his closing remarks about additional funding. Given the current status of basic research and development, and the development of ARGO-Maine, what's the next step? Where do we go from here? What is your and our highest priority? Are we talking about sustained funding with additional funding needed to implement the research programs in addition; or allowable research data; new research priorities? What is the most important next step in a series of steps that you envision? Perhaps we can address that in the order that we spoke. Dr. Yentsch?

Mr. **Yentsch**. I think in your opening comments, Senator, you used the word "stable." Present Federal funding per basic science—basic marine science—is anything but stable at the present moment; consequently, none of us can afford the luxury of the belief, say, a decade of our research talents toward the study, on a long-term basis, of a body of water such as the Gulf of Maine.

So we need, to begin with, a stable source of money. Now, that money, in my opinion, must be focused on, again, this term "whole ecosystem analysis," and that analysis has to be coupled very closely with the climatological events that occur so frequently in this part of the world. This requires a lot of monitoring of both meteorology and oceanography and basic biology of the system.

It's a program you have very great difficulty in finding funding for at the present time, and since this region is not in a catastrophic state, many agencies that might be concerned really are not concerned. So it takes an initiative of quite a need, but one that, as I have said, the cost to benefit ratio very much favors both the national and the state scene, and being something beneficial and highly rewarding in the long term for all.

Senator **Mitchell**. Mr. Brennan.

Mr. **Brennan**. Senator, I would add to what Doctor Yentsch said by drawing attention to something you realized early on in the debate over the condition of our waterways and the formation of the Clean Water Act, that what will solve the need is a partnership, a partnership of those resources within states, regions, and the Federal Government. I think what that really means is we need to identify where those sources of funding exist and how it can be utilized to support efforts such as we have in this State and region.

Wide rumor comes to mind—and in many respects when you're talking about trying find monies you're referring to rumor—but it's my understanding that there has been a substantial number of dollars recently transferred from NOAA to EPA for some more on the eastern seaboard. It's finding out where those monies exist and how to count them into efforts such as we see even here in the State of Maine.

Senator MITCHELL. Doctor Lick?

Dr. LICK. I think one of the important things is one that you've already talked about, and that is ARGO-Maine, itself, and what it potentially can mean to the development of Maine. We have gone far enough now to realize that, as a collective group of organizations, we can work together cooperatively to do things that none of us can do individually. Each of us has a very important role to play.

We've put down a good beginning in terms of a plan, in terms of prioritization, in terms of an initial step forward to try and implement that long-range plan we just heard some talk about. We need to refine that plan and continue to move it forward.

We need also to realize, as several have suggested, that the problem isn't one that we must jump on with both feet today and stop tomorrow. It really is a longer-term kind of problem that requires we gather data and deal with that data as we understand it better, and as we see problems that will be occurring as a result of things that may be beyond our control as a State.

What we need is good baseline data and a good understanding of the characteristics of the Gulf of Maine. It will take a substantial amount of money. I would encourage that to be spread out over a long period of time so that, in fact, we do have a good holistic approach to the Gulf of Maine. Don't just deal with any single problem today, but set up a systematic approach so that, in fact, we can deal with the problems during this decade, during the next decade, and so forth. That is, after we get the base data, then updating and making it a very reasonable task in future years as opposed to jumping on every single problem that comes along. So I would encourage a long-range approach.

I would further encourage that, in fact, ARGO-Maine, assuming that funding were to come forth to support this, would be challenged—expected, in fact—to work with the citizens of the State and the various organizations and groups that deal with the marine base that we have. We have an exceptional marine base which I think sometimes we take for granted. I think we need to make sure we couple scientific research with an explanation to the people of Maine so they begin to understand just how fragile this system is and how they, too, are responsible for it; and those who have been taking from the water—and want to continue taking from the water, and should—need to understand it must be done in a sustained sort of a fashion; not raping the sea to make a lot of money now, but, in fact, working with the scientific community, and others, to make sure that it is sustained over a time and can be continued as a tremendous resource.

So what I'm suggesting, is—first of all, what we undertake is a relatively long holistic approach to getting on top of the characteristics of the Gulf of Maine so we can protect it short term and long term. I'm stressing, indeed, it will take a sizeable sum of money for us who are planning to do that.

But I'm suggesting that we share that burden and that understanding of the fragile nature of the Gulf of Maine with those who fish it, with those who swim in the waters, with those care about its beauty, and with those who live on the shorelines, so that we are all protectors of the Gulf of Maine. As I mentioned, it is one of the five most productive bodies of water in the world.

Senator MITCHELL. Governor, before you respond, an earlier answer demonstrates how correct you were in your earlier remarks. The recently enacted Federal Clean Water Act approved a $50 million authorization for the clean-up of the Chesapeake Bay spread over 5 years. That does not include the cost of private research in assessing the problem, and it may be insufficient to deal with the whole problem. You made your point that it's better to spend money now improving research in limited amounts rather than spending much more later to clean up what may be a large and irretrievable situation. I'd be interested if you wanted to amplify on your remarks—if I could ask you to do that, and at the same time: you've served with great distinction in many public positions, including ambassador to Canada, and you're a recognized expert in this country on U.S.-Canadian relations. If you could also comment on whether or not you are familiar with any Canadian research efforts in the Gulf of Maine, and is there any possibility or potential disadvantage in attempting to coordinate activities in that regard?

Mr. CURTIS. The first question I will just amplify a bit that there does seem to continue to be pockets of money being expended in reference to the Gulf of Maine through various entities. We now, in the State of Maine, can say that our research activities are coordinated so that we are not wasting our effort in what we do here. I think that ARGO-Maine is highly capable of helping develop a scenario by which we would pursue over, say, a 5 or a 10 year period.

I think it would be important if somehow or other that planning, perhaps through this subcommittee, could involve Federal agencies who already have different interests in order that perhaps you in the Senate and the Congress could perhaps more efficiently and effectively direct those funds to a planned effort rather than what is a rather, I think, uncoordinated, small interest that's going on at the moment.

And in that regard I think that it would be very short-sighted for us to begin our activities of research and efforts at the Canadian border—certainly as it pertains to issues north, particularly in the province of Nova Scotia. Indeed there, I think, Canadian Government, itself, places a great deal of emphasis on conservation—at least in fish and its resources in our eastern part of the United States.

They have their large oceanographic research facility in Halifax. I know that the Ministry of Fisheries in Nova Scotia in Brunswick, there, for many years has been in contact with our counterparts, particularly being in much smaller scale in the coastal United States.

So I think this, certainly as we move forward with the scenario of long-range planning, we ought not forget working with the Canadian research.

Senator MITCHELL. Thank you, Governor.

Doctor Lick, I wanted to ask you a question about the Sea Grant Program. You mentioned that in your testimony as the mainstay of the Marine Research Program at the University.

There's always the risk that funding for the Sea Grant Program will be reduced. What effect would cut-backs have on the university's marine research program, and the broader efforts of ARGO-Maine if the Sea Grant Program were reduced?

Dr. LICK. Well, at the present time, the program is one of 32 in the nation—we share it with the University of New Hampshire—it is funded at about $1.5 million per year, with a little over $800,000 coming to Maine, and a little less, a little over $600,000 going to New Hampshire. I think that program has shown the kind of success one can have with a broad-base approach in trying to deal with some of these marine problems. We have been very successful. It reflects results and solutions to problems across the board. Those, probably, are broader than one would normally undertake if one were going over the kind of approach that we've been talking about here today because the money just isn't big enough to cover that broad array.

Probably, if the funds were cut back we would see several things happening. First of all, we would obviously have to reduce our research efforts in the Gulf of Maine, which in and of itself would be negative because it represents a major part of the research going on there, whether it's lobsters or whether it's various kinds of fish, or whether it's with anything, even with the bottom, in particular, and that's where the bulk of our productivity is: things dealing with the bottom of the Gulf.

But more importantly than just the productivity and research would be the various kinds of programs that we are involved in with anybody relating to the marine base, whether it's the fishermen themselves or whether it's the harbor masters, or whatever the case may be, under Sea Grant we are challenged to respond to all of those needs, and we try very hard to do that. It's a very broad, broad charge.

A lot of people in Maine would suffer as a result of cutback in Sea Grant. That's probably the broadest-based research and public service program that the state has relating to the marine area, so it would be a major step backwards if that happens. We hope that does not happen.

A similar kind of situation would happen if the Land Grant Program were cut back, those go a somewhat parallel to one another.

Senator MITCHELL. Thank you. I want to go on to the next panel in order to complete hearing. Thank you all very much for your testimony.

Mr. BRENNAN. Mr. Chairman, I'd like to have entered into the record the statement of Walter Anderson, director of the Maine Geological Survey of the Maine Department of Conservation, a member of ARGO.

Senator MITCHELL. Thank you. That will be done.

Thank you very much, gentlemen.

We'll now call on the next panel: Mr. Edward Blackmore, Mr. Thomas Jordan, and Mr. Jeffrey Kaelin. Please come forward.

While they're doing so, for the record I would like to identify Jeff Peterson, who is here with me and who is a member of the staff of the Senate Subcommittee on Environmental Protection, and has organized this hearing.

I want to welcome you, gentlemen. Thank you very much for coming. We'll begin with Mr. Edward Blackmore, president of the Maine Lobstermen's Association. Ed, welcome. It's good to see you, and we look forward to hearing from you.

STATEMENT OF EDWARD BLACKMORE, PRESIDENT, MAINE LOBSTERMEN'S ASSOCIATION, NEW CASTLE, ME

Mr. BLACKMORE. Thank you, Senator Mitchell. Thank you for the opportunity to appear before you.

It would seem that these hearings are very appropriate and timely. Management of our fishery resources without the proper environmental impact assessments is, in effect, mismanagement. We, as a state and as a nation, have seen the devastating effect of this kind of mismanagement. Most of the environmental studies relating to fishery management have been after the fact, rather than before, which is kind of like locking the barn door after the horse has been stolen.

Studies must be designed and completed that will accurately establish levels of pollution in the Gulf of Maine.

During the time that I served as a member of the New England Fishery Management Council I became acutely aware of the importance of accurate information and its application with the intent to effectively manage our fisheries. It is my opinion, based on my many years of experience, that environmental concerns have never had priority in the overall scheme of fishery management. In recent months we have had concerns expressed by individuals and environmental groups using information that is inaccurate and outdated.

We are in desperate need of applied research that is designed to answer specific questions. I cannot stress enough the importance of research projects being done in cooperation with industry. If industry is expected to accept the findings of scientists and work cooperatively to correct environmentally unsafe situations, they must be recognized as a working partner of science whenever possible. Every fisherman is a scientist in his own right. He observes on a daily basis over long periods of time and applies the results of his observations to his particular fishing activities and habits.

It is important that our scientific information be wide-ranging and applicable to present situations. There is much information available that pertains to the Gulf of Maine that has been gathered by researchers. If this information is available, we should take advantage of its availability. The results of any research should be made available in a language that nonscientists can easily understand.

The State of Maine has a reputation for clean air, clean water, and an overall high level of concern for the environment. We must back up these conceptions with documented evidence that will quiet any speculation based on flimsy information by individuals who are trying to make news rather than looking at good available information.

Most people involved in marine science, environmental concern, and fishery management are acutely aware that funding for all types of research is diminishing while need is increasing. In order to properly address our current needs, we must look at all areas of funding: state, Federal, and private industry.

One area that I feel where changes can be made is in the area of priorities. My experience tells me that many state and Federal agencies resist changing priorities. They become very complacent and relaxed doing what they have been doing without interruption or change. Yesterday's priorities are not necessarily today's priorities.

There are still large amounts of money being spent on research. Our job is to channel the right amount of research money, along with the right highly concerned and motivated people in the right direction, thus receiving the most bang for the buck from our research dollar.

I support 100 percent full cooperation between science, environmental groups, and industry to achieve together what we cannot possibly achieve alone.

With the help of the Federal Government I am sure that we can work together to accurately determine what environmental dangers we are facing.

Thank you.

Senator Mitchell. Well thank you, Ed.

We'll now hear from Tom Jordan, the president of the Maine Fishermen's Cooperative, Portland, Maine. Tom, welcome.

STATEMENT OF THOMAS C. JORDAN, PRESIDENT, MAINE FISHERMEN'S COOPERATIVE, PORTLAND, ME

Mr. Jordan. Thank you, Senator.

In the past 10 years, fish—including shrimp, mackerel, codfish, whiting, flatfish, and herring—have not seemed to be coming to shore as the used to to spawn. Stocks are down, but the fish that are available are still not coming in to shore to spawn like they used to. These fish seem to come to within ten miles of shore to spawn. We do not know why the pattern has changed. Is it water temperature, or is it—worse—pollution?

Maine has always been a leader in marine research, including clams, mussels, herring, groundfish, pollution. Some monitoring is done by the State, but it is mostly Federal funding and is contracted out to the MVTI's. Project impact assessment is done on the State level for rivers, but little has been done for the Gulf of Maine.

I think the State should monitor waters for pollution, water temperature change, and salinity changes. Also, I think we should continue monitoring coastal development, landfills, dredging, sewerage dumping—not just from the mainland, but from the outer islands, as well.

Coordinating these efforts should be done on the Federal level, possibly through Regional Council, since it is the only agency able to tie an interstate project together.

Thank you.

Senator **Mitchell**. Thank you very much, Tom. You've been very helpful today.

Next we'll hear from Jeff Kaelin, the executive director of the Maine Sardine Council. Jack, welcome. We look forward to hearing from you.

STATEMENT OF JEFFREY H. KAELIN, EXECUTIVE DIRECTOR, MAINE SARDINE COUNCIL, BREWER, ME

Mr. **Kaelin**. Thank you, Senator.

In addition to working as the executive director of the Maine Sardine Council, I am also a member of the Department of Marine Resources Advisory Council, Vice President of the Associated Fisheries of Maine, and a member of the University of Maine/University of New Hampshire Sea Grant Policy Advisory Committee. In all of these capacities the issues of the environmental integrity and production of the Gulf of Maine, along with the adequacy of the research efforts directed towards a better understanding of the Gulf, are extremely important.

I think these research efforts are essential because the irreversible contamination of our air, water, and food supplies is obviously a major issue today, but I'm convinced, however, that we can reduce this threat and stop the decline in the health of our coastal and estuarine areas by continuing and building upon existing research and monitoring programs to ensure the future productivity of our renewable ocean resources. Your interest and assistance is sincerely appreciated in this endeavor.

In Maine we're fortunate that our coastal areas remain productive and clean. The National Oceanic and Atmospheric Administration's National Status and Trends Program, which you spoke of in your opening remarks, has identified both the Casco Bay and Machias Bay areas as being very clean in comparison to many other coastal areas of the country.

Continuing a national monitoring and assessment program such as that one is essential to protecting the Gulf and our coastal regions from additional contamination and a possible resulting loss, again, in the availability of our fish and shellfish resources.

While research of this type should continue to be both a national and state priority, I believe we must also develop the capabilities to determine the actual health risks associated with various levels of contamination. To paraphrase a statement attributed recently to a General Mills Food scientist, "Our ability to detect has far exceeded our ability to interpret."

We need facts, not fears, to ensure a wholesome food supply and avoid marketplace hysteria. Rational, scientific conclusions and dollars for research into the prevalence and effect of contaminants in the ocean environment are prescriptions for avoiding a seafood marketing disaster.

A second area which must also remain a priority concerns the continued funding of research in support of fisheries management, as Ed has spoken of a minute ago. Our fishery management system is a sound one, and the process is benefitting from the efforts of many commercial fishing interests who are committed to working with both the Federal and State governments to cooperatively and conservatively manage our fishing resources.

Wise fishery management decisions can only be made with sound scientific knowledge, however. The funding cutbacks which the National Marine Fisheries Service and the grants-to-states programs have had to endure over the last several years have directly translated into less adequate resource information from which to make sound management decisions.

Money has to be found and made available for funding research of this nature, not only to protect our fisheries resources, but also to encourage participation of the fishing industry in the management process through creating a better information base.

Here, in Maine, inadequate scientific information on the abundance of the region's herring resources created a controversy over a recent allocation of fish to a foreign factory vessel. Because dollars for research into the abundance of fishery stocks in the region are limited, there has not been an assessment of the year class composition of the herring stock—an index which is important to determining a stock's health—in several years. It is impossible to make reliable allocation decisions without reliable information.

Several research programs focusing on Maine's herring resource, in particular, are in place here in the State, but research dollars remain inadequate from our perspective. Bilateral cooperation is also ongoing as Maine and Canadian researchers are working together to understand the herring resource's mysteries.

One aspect of this work is utilizing experimental hydroacoustic technology to assess the viability of the region's herring stock. A modest industry grant was awarded recently by the Maine Sardine Council to assist this project in order to encourage the development of a more informed estimate of the resource's strength.

While I believe that industry contributions for research in support of management are important and should be encouraged, I do not believe that industry funds, alone, would generate sufficient marine research to answer even a small number of fisheries management questions.

Continued Federal support for fisheries-related research projects are vital to expanding our understanding of the dynamics of the variables involved in fisheries management such as recruitment, fishing pressure, predation, and changing climatological and oceanographic conditions. The expenditure of public money for this purpose is justified by the significant economic returns which our fishing industry generates in our coastal economies, and by the benefits the nation's seafood consumers receive from an abundant supply of wholesome seafood products.

Finally, I want to mention an area of marine research policy which deserves refocused Federal attention: the Marine Mammal Protection Act. While the protection of viable populations of marine mammals is a laudable goal, the Marine Mammal Protection Act's "maximum sustainable population" standard is at cross purposes to the ecosystem approach being taken in fisheries management. The MMPA should be amended to encourage research into predation as an aspect of fisheries management policy. The penalties which stem from the MMPA's absolute protection goal will continue to significantly hamper efforts to focus on the predation variable in the fisheries management equation if changes in the Act are not forthcoming.

As we work to understand the productivity and complex relationships of the ocean ecosystem, wise management policies and studied scientific conclusions—not protectionist policies or pseudo-science in support of political agendas—will provide us with the greatest long-term economic benefits from our coastal resources. Adequate research efforts are essential to that success.

Thank you for the opportunity to share our views with you today. We look forward to continuing to work with you and your staff and the other Members of the Delegation to ensure the sustained productivity of the Gulf.

Senator MITCHELL. Thank you very much, Jeff.

I thank each of you. Your testimony is particularly significant since you are here as representatives of the fishing industry. I want to ask you a couple of questions in that regard.

What kind of research would be particularly helpful to fishermen? Do you have an opinion on that?

Mr. BLACKMORE. Well, I think that it's important, with the amount of pressure that's being put on all the fisheries in the State—the lobster fishery, the cod fishery, the herring fishery—and with the aquiculture coming on the scene fairly strong here in recent years, and I think we have to determine, as best possible, what effect one fishery is having on another. Are we encouraging one fishery at the expense of an existing fishery? These are things that we should know. If we're not, fine, we should know it. If we are, we could be aware of it. If our particular method of harvesting a certain species is destroying more of that species than we are landing, then we should know this so that we can design our harvesting methods to more efficiently harvest that resource so that we don't have these big kill-offs that we may be experiencing from our operating methods. So these are some of the things.

I didn't mention before, but I am serving as the chairman of the newly-formed Maine Lobster Institute Advisory Group that Doctor Lick mentioned, and we are very anxious to move this organization into the forefront of research projects that are of grave need in the lobster industry in this State, and we have found the Sea Grant People and Marine Outreach Program at the universities very responsive to our needs, and we certainly, up to this time, have enjoyed working with these people, and we hope that we will go along that road together.

Senator MITCHELL. In your statement, Tom, you had mentioned some areas you thought that should be subject to research. Do you have any others that you think would be particularly helpful to fishermen?

Mr. JORDAN. Well, I'd like to see some of the research done in cooperation with the fishermen, who are out in the seas roughly 280 days a year. We never see anybody come down and ask us, "What do you see out there? Could we go out with you." We would like to work with these people as much as we possible could to let them know what our feelings are and what we're seeing going on out there. Nobody's out there more than we, the fishermen, are.

Senator MITCHELL. More direct participation by fishermen in research projects?

Mr. JORDAN. Correct.

Senator MITCHELL. All right. Thank you.

Jeff.

Mr. KAELIN. I think I'd need to go maybe one step further, and that is more participation by fishermen in the research planning process, too. Particularly that which the Fisheries Service utilizes. This may be a three-year priority for a program where their priorities are being established two to three years before actual work is being done. It just seems to me that it's very difficult to get research focuses directed toward the questions you'd like to have answered as an industry person. I think that, the fisheries research process does not utilize the fishermen's input enough.

Of course, I'm speaking today from a little different perspective. I was a fisherman, but I also represent processors—the availability of resource information through processors is of extreme importance as well. I think that the lack of a good information base from industry in the information process is a significant problem. I recognize, however, that this is a fairly young process. The management process has only been in place about eight years, so it takes a while to learn.

But certainly from the herring processing perspective, right now there's a lack of information on the viability of that stock which is significant.

Senator MITCHELL. In your statement, you mentioned some concern about the reliability of some recent reports on environmental conditions in the Gulf, and I share that concern. The question to you, and the other members of the panel: who, if anyone, do fishermen and others in the industry regard as providing accurate information? You observe lobstermen, Tom, and fishermen.

Mr. JORDAN. Fishermen.

Senator MITCHELL. Fishermen.

Anybody else? Ed? Is there a single source that is considered most reliable?

Mr. BLACKMORE. Well, over the years I haven't had that good feeling that, you know, I could get reliable information from the various research people that have spent all this time involved in the research. As I said in my statement, in order for fishermen to feel comfortable with the research, and to accept the research results, they have to be involved in it.

You probably read in the "Bangor Daily News"—maybe it was last Saturday's paper, or maybe it was Monday's paper—the project that was being done by the Darling Center down in Waldole where an area was closed off to do a study of the losses in a certain area, and this was done with full cooperation of many fishermen in the area. Our association certainly was instrumental in setting this whole project up. The people involved there—most of them were our members. It never could have been done by just a research group going out there saying "We're going to shut off this area, and we're going to research this." There would have been a small war. But the thing is, you know, the right approach was taken here.

We want to get some information for you—accurate information—so that we can manage this fishery more efficiently, and we'd like to have your help. This is what they did, and did it in a very good frame of mind, and I think this could be a pattern.

Senator MITCHELL. Is there any one source of information, Tom, we've got that's accurate?

Mr. JORDAN. We read a lot of things—a lot of research, stuff that comes out. The best information we get is amongst ourselves. We find out more information by working with the boats around the Gulf of Maine, talking to one another—not just Maine, but through the Massachusetts boats—and get our information there.

Senator MITCHELL. Jeff, do you want to comment on that?

Mr. KAELIN. I guess over the years we've just relied on a number of different sources, and we continue to do that with the National Marine Fisheries Service or the Department of Marine Resources. I think we have a very good relationship with DMR scientists there. But, the you know, Sea Grant Program: there's some good work that comes out of that. So I guess we just try to take a look at all of it and see if any of it is answering the questions you're trying to have answered.

I keep thinking that maybe I'm just hopelessly optimistic, but I recognize it's a relatively new system: understanding the complexities of the ocean ecosystem. It's only been out there a few years—which of the technology we've got today. I keep holding out hope that someday we'll have better information if we keep trying and directing more research toward different areas. I think those people involved in creating priorities for spending research money should spend more time with the industry and listen to the individual people that go out on the water all the time. They certainly know an awful lot about what's going on out there.

So I guess it is just a kind of generic system that's still developing, and you want to take advantage of every opportunity for information that there is.

But right now, I'm quite pleased with the information that exists in the herring research area in this part of the world.

Senator MITCHELL. Thank you all very much. You've been very helpful, and I look forward to continuing to work with you in the future on this.

Mr. BLACKMORE. Thank you.

Mr. JORDAN. Thank you.

Mr. KAELIN. Thank you.

Senator MITCHELL. The next panel includes Ms. Anne Johnson, director of Marine Programs, Maine Audubon Society; and Mr. Charles Ehler, director of Office of Oceanography and Marine Assessment, National Ocean Service, National Oceanic and Atmospheric Administration, Washington, D.C. Welcome, Ms. Johnson and Mr. Ehler. We look forward to hearing from you.

Ms. Johnson, why don't you begin?

STATEMENT OF ANNE C. JOHNSON, DIRECTOR OF MARINE PROGRAMS, MAINE AUDUBON SOCIETY, FALMOUTH, ME

Ms. Johnson. Thank you, Senator.

Maine Audubon is committed to conserving Maine's nature resources through research, education, and advocacy, and has recently launched a program directed at protecting and enhancing the ecological integrity of Maine's marine environment.

Before coming to Maine Audubon, I worked with Peter Larsen at the Bigelow Laboratory on several pollution-related studies. These studies have, in part, helped to raise concern about environmental degradation in the Gulf of Maine that has culminated in today's hearing.

Reports of pollutant accumulation in the Gulf of Maine can be viewed as good news for Maine. Good news because they indicate that Maine does not suffer from the serious problems facing places such as Boston and New Bedford. Good news because awareness of a pollution problem in its very early stages greatly increases the likelihood that measures can be taken to protect our invaluable marine environment.

These reports should serve as an early warning signal to the Federal Government, the State, fishermen, scientists, and the environmental community. Now is the time to address the problem, to ward off potential degradation of the Gulf ecosystem and concomitant economic hardship. It is our responsibility, as stewards of the environment, to take appropriate action to safeguard the ecological integrity of the Gulf.

Hydrocarbons, trace metals, and some synthetic contaminants are accumulating in the sediments of the major embayments of the Gulf of Maine. In some cases, concentrations are similar to those found in more heavily industrialized areas.

Contrary to the popular conception that pollution dissipates in an almost infinitely large ocean, these contaminants settle out near their point of introduction to the marine environment. While water column analysis may reveal little or no pollution, contaminants are slowly accumulating in near shore sediments.

I do not believe that PAH's or trace metals in the Gulf of Maine currently pose a threat to public health; however, I am concerned that they may be adversely affecting the environmental health of the Gulf. Analysis of data collected in our baseline survey of Penobscot Bay sediments revealed a correlation between PAH concentrations and changes in faunal community structure.

Pollution correlated changes in the benthos may indicate that the larger marine ecosystem, including fish stocks, may be at risk. The greatest risk for Maine's fisheries is not concern for public health—founded or unfounded—but rather the negative impact of contaminants on fish productivity. While concern for public health must be paramount, I believe that by protecting environmental health we also protect public health and, in the long run, the health of our marine-resource-based economy.

Existing data on pollution impacts in the Gulf of Maine have not resulted from a comprehensive program, but rather from a small number of unrelated projects with varying objectives, timetables, and resources. In the early 1980's NOAA's Northeast Monitoring

Program provided funds for our baseline surveys of Penobscot and Casco Bays. That program was scrapped in favor of the current Status and Trends Program, which regularly samples only one or two stations in Maine as part of a nationwide program.

Maine's marine waters were recently classified. The classification process is goal oriented; however, there has been no sampling to assess how closely such goals are being met. In fact, there is little or no data on water quality for most of the Maine coast. The only regular sampling of Maine's marine environment is conducted by DMR to protect consumers of shellfish from the ill effects of red tide and domestic sewage. There is no consistent program to monitor sediments or organisms for toxic compounds such as hydrocarbons, trace metals, or synthetic organics to protect either public or environmental health.

To rectify this situation, the Maine Department of Environmental Protection has recently started a new marine monitoring program. Pilot sampling was carried out at one site last year. Lack of funds has jeopardized the planned expansion of this program to an additional four sites this year. At this point, the program has more value as an educational tool in raising awareness of the marine pollution issue than in addressing the nature of the problem.

While the recent Coast Alliance report may have exaggerated the risk to consumers of eating Maine seafood, reaction to the inflammatory portions of the report overshadowed some very legitimate conclusions of the study: neither Maine nor the Federal Government has any significant, comprehensive program for assessing the health of Maine's marine ecosystem.

The Federal Government can play a role in protecting the environmental quality of the Gulf of Maine in five areas: first, funding for research and monitoring programs. In order to protect the Gulf we need to know more about it. Funding is especially needed for research on the source, fate, and effects of pollutants.

While research will provide us information on mechanisms of pollutant transport and impact, monitoring plays a complementary role by specifying the nature and extent of contamination. Research and monitoring together will provide a picture of the risk to the Gulf from pollution.

Second, technical support. A Federally-funded sample processing facility, perhaps serving a multi-state region, would standardize results, assure quality control, and reduce the burden on state laboratories and resources of processing large numbers of samples.

Third, development of regulatory standards and guidelines. Regulatory activity on the part of the Federal Government can also foster protection of the coastal and offshore environments. Federal regulations of shellfish harvesting in the vicinity of sewage discharges played a major role in the recent enactment of significant pollution control legislation in Maine, which banned new overboard discharges of residential sewage.

The promulgation of similar Federal regulations regarding other contaminants would provide incentive for additional discharge prohibitions. Such regulations, expanded to protect environmental as well as public health, would do much to reduce point source pollution.

Fourth, coordination and oversight. The Federal Government can play a vital role in the research and monitoring programs in the Gulf of Maine by coordinating and promoting the participation of State, Federal, and provincial governments in efforts to protect the Gulf.

Fifth, focus on preventive measures. As a major objective, a research program for the Gulf of Maine must answer the resource manager's question: "What can we do to protect marine environmental quality?" As a condition for funding, the Federal Government can impose a set of objectives on the proposed program to ensure its relevance to the overriding goal of protecting environmental quality in the Gulf.

In conclusion, I thank you for the opportunity to express our views on this timely and important issue.

Senator Mitchell. Thank you, Ms. Johnson.

Mr. Ehler, welcome. We look forward to hearing from you.

STATEMENT OF CHARLES N. EHLER, DIRECTOR, OFFICE OF OCEANOGRAPHY AND MARINE ASSESSMENT, NATIONAL OCEAN SERVICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, WASHINGTON, DC ACCOMPANIED BY ROBERT MURCHELANO, CHIEF, ENVIRONMENTAL PROCESSES DIVISION, NOAA NORTHEAST FISHERIES CENTER, NATIONAL MARINE FISHERIES SERVICE

Mr. **Ehler**. Thank you, Senator.

I am Charles Ehler, the director of NOAA's Office of Oceanography and Marine Assessment within the National Ocean Service. Accompany me today is Dr. Robert Murchelano of NOAA's Northeast Fisheries Center, within the National Marine Fisheries Service. Dr. Murchelano is the Chief of Environmental Processes Division at the Northeast Fisheries Center at Woods Hole, and an expert on the effects of pollutants on fish.

I am pleased to summarize our current assessment of environmental quality conditions in the Gulf of Maine, and to describe NOAA research and monitoring programs that are relevant to this hearing.

The marine environment of the Gulf of Maine is characterized by three principal ecological regimes: the Gulf of Maine Basin; Georges Bank; and the Scotian Shelf. These ecological regimes play a major role in determining the distribution and abundance of commercial fish and shell fish in the Gulf of Maine area. The physical features of the three principal ecological regimes in the Gulf of Maine area, together with the Northeast Channel, largely determine the circulation patterns of the overlying waters. The circulation patterns and other physical characteristics of the overlying waters, in turn, largely shape the communities of plants and animals within them.

Mr. Chairman, my written testimony discusses in some detail the various water masses and circulation patterns in the Gulf of Maine, and their influence on the distribution of phytoplankton and zooplankton, and I won't——

Senator **Mitchell**. I might say that's very informative, Mr. Ehler, and I thank you for that.

Mr. **Ehler.** The small animals, the zooplankton and phytoplankton, in turn, determine to a large extent the location of other species, including commercial fish and shellfish.

About 200 species of fish and shellfish can be found in the Gulf of Maine area, of which 40 to 50 species are of commercial significance.

Catch-per-day fished has declined sharply as abundance of traditional species, such as redfish, cod, and flounders has declined and effort has increased. The decline in otter trawl catches of these species has been partially offset by increased landings of lower-valued species such as pollock and silver hake. Fisheries in the Gulf of Maine are directed towards 12 species that comprise approximately 70 to 80 percent of the total catch.

Again, Mr. Chairman, my written testimony includes a brief assessment of trends in commercial landings and stock abundance for each of the major fisheries in the Gulf of Maine, and I won't read that in my oral testimony.

What I would like to focus on is our assessment of environmental quality conditions in the Gulf of Maine.

A comprehensive evaluation of the status of chemical contamination in sediments of the Gulf of Maine was conducted by the Bigelow Laboratory for Ocean Sciences in the early 1980's. The Gulf of Maine and Casco and Penobscot Bays were sampled for: polynuclear aromatic hydrocarbons, PAH's; polychlorinated biphenyls, PCB's; and trace metals in sediments. Thirteen of the 16 PAH compounds designated by the EPA as "priority" were found in the Gulf. Concentrations of these materials in deep water surficial sediments were at least an order of magnitude lower than were observed in coastal regions.

The basins of the Gulf are depositional areas for fine-grained particles and for organic carbon. Although the Wilkinson and Jordan Basins appear to be areas of PAH accumulation, PAH's are not accumulating in Georges Basin. Atmospheric transport is probably the principal mechanism through which PAH's are introduced to the Gulf.

Detectable PCB levels were found in all the sediment samples examined. Stations with highest PCB levels were in the western Gulf, closest to the industrialized regions of New England. The levels found were comparable to those encountered in the New York Bight and Long Island Sound. As is usually so, PCB concentrations were highly correlated with total organic carbon and fine-grained sediments. PCB concentrations are strongly correlated with depth in Jordan and Georges Basins, indicating that these basins are depositional areas for this pollutant. No significant correlation between depth and PCB concentration was found for Wilkinson Basin, which is located in the western Gulf.

Trace metals and PCB's were found in Casco Bay. However, in Penobscot Bay only trace metals were detected in elevated concentrations. PAH's were found in both Casco and Penobscot Bays; in Penobscot Bay they were found in high concentrations, particularly at the head of the estuary.

These findings are generally consistent with more recent results from NOAA monitoring activities. Since 1984 NOAA has sampled, through its National Status and Trends Program, approximately

150 sites nationwide, including a number of sites in the Gulf of Maine, to determine levels of toxic chemicals and heavy metals in selected bottom-feeding fish, shellfish, and associated sediments.

Annual samples of fish and sediments have been taken through the Benthic Surveillance Project—part of the National Status and Trends Program—at sites in Machias Bay, Frenchmans Bay, Penobscot Bay, and Casco Bay, all off the coast of Maine, and at sites at the mouth of the Merrimac River and in Salem and Boston Harbors. Annual samples of mussels and sediments have also been taken in 1986 and 1987 at two additional NOAA Mussel Watch sites in Penobscot Bay, one at Cape Ann, and four in Boston Harbor.

Based on the 1984 benthic surveillance data only, the sediments of Boston Harbor and Salem Harbor contained the highest concentrations of PCB's and PAH's of the 50 sites sampled nationally through the benthic surveillance program.

Both harbors also ranked in the top five sites across the nation for DDT contamination. Boston Harbor sediments were ranked among the top five sites for concentrations of cadmium, chromium, and lead in sediments. While no other sites that NOAA sampled in the Gulf of Maine area showed concentrations approaching those found in Boston and Salem Harbors, Casco Bay contains sediment concentrations of PAH's and DDT's that were well above typical values. Casco Bay also had the highest concentration nationally of any site for lead in fish liver tissue, with Boston Harbor and the mouth of the Merrimac River also showing elevated levels.

Casco Bay and the mouth of the Merrimac also had the third and fourth highest concentrations, respectively, of silver in benthic fish livers.

Additional measurements are required, obviously, to determine with more confidence the long-term trends in concentrations of these pollutants in these areas, and additional research is needed to determine the effects of these concentrations of pollutants on fish populations over time.

In addition to data from the NOAA National Status and Trends Program, other data are available to evaluate environmental conditions in and around the Gulf of Maine area. For example, data from the "1985 National Shellfish Register of Classified Estuarine Waters," compiled by NOAA and the Food and Drug Administration, primarily state data, show that almost 113,000 acres, or about 15 percent of shellfish growing waters in estuaries bordering the Gulf of Maine, have some limitations placed on harvests. These limitations represent a significant economic loss to the commercial and recreational fishing interests of the region, as well as indicate some serious problems in the environmental quality.

Mr. Chairman, clearly more concern about the effects of pollutants in living resources must be faced on estuarine and near-coastal waters. The important role that estuaries play in sustaining the health and abundance of marine fishes, shellfish, and other animals, has been recognized for a long time. However, only recently has attention been focused on the total mix of multiple goods and services that these areas provide.

To provide decisionmakers a consistent, uniform information base with which to evaluate conditions across major estuaries, NOAA has been constructing, since 1984, a National Estuarine Inventory of the 100 most important estuaries of the continental U.S., including 13 estuaries from Passamaquoddy Bay to Cape Cod.

Two major NOAA data atlases of characteristics of these estuaries have already been published: one on physical and hydrologic characteristics in 1985, and one on land use characteristics in 1986. There are a number of other atlases in preparation, including some important ones on pollutant discharges to these important estuaries. All of these atlases are available from NOAA's Office of Oceanography and Marine Assessment, and I'd be happy to provide them to you.

Senator, because of your subcommittee assignment I know you have an interest in EPA, and you know that in 1985 EPA began a "Near Coastal Waters Initiative" to explore improved methods to manage estuaries and near-coastal waters. I am pleased to report that NOAA and EPA have recently formed a joint team of Federal scientists, engineers, and analysts that is developing a series of information products that will define a consistent set of spatial units for the organization of information about estuaries and the assessment of near shore waters, to also identify nationally significant estuaries, and to plan to develop improved methods to assess problems with and across estuaries.

Several documents have already been produced, and a synthesis of estuarine and coastal information for EPA Region 1, covering 17 estuaries, again from Passamaquoddy Bay, in this case, through Long Island Sound, is underway and will be finished this fall.

Formation of this joint NOAA and EPA team signals an increased commitment by both agencies to address cooperatively environmental quality problems in estuarine and near coastal waters.

Senator, NOAA and its predecessor agencies have conducted surveys and research in the Gulf of Maine since 1808 when Thomas Jefferson established the Survey of the Coast. In the nineteenth century the Survey and its successor agencies developed accurate bottom profiles of the Gulf of Maine and the Georges Bank, and this work continues today through the National Ocean Service.

The world's first major fisheries research lab was also established in 1885 at Woods Hole, Massachusetts. NOAA's Northeast Fisheries Center, located at Woods Hole, continues to conduct important research on the fisheries of New England.

And, finally, NOAA's Sea Grant College Program sponsors studies that have added to the scientific knowledge of the Gulf of Maine. The Woods Hole Oceanographic Institution Sea Grant Program, the MIT Program, and the Maine/New Hampshire Program have all conducted fruitful research in the Gulf of Maine that has produced much of the information that I have presented today.

This concludes my written testimony, and I would be happy to answer any questions that you might have.

Senator MITCHELL. Thank you very much, Mr. Ehler. That's a very informative statement, and you provide a lot of useful information.

Regarding the Sea Grant Program, in your written statement you mention that the President's proposed budget for fiscal year 1988 would terminate funding for the Sea Grant Program, and you describe the rationale for that in your statement. That, I must say, concerns me particularly in light of the earlier testimony by Dr. Lick and others of the importance of the program here in Maine. Am I correct in my recollection that a similar proposed termination of the Sea Grant Program has been included in each of the President's budgets for previous years?

Mr. EHLER. Yes, sir. I believe that the Administration has consistently proposed the funding of the Sea Grant Program.

Senator MITCHELL. And in each of the previous years the Congress has rejected that recommendation and has continued the funding of the Sea Grant Program?

Mr. EHLER. That's right.

Senator MITCHELL. Well, I'm confident that will encourage them this year, but I must say I'm concerned about the messages it sends out regarding the proposed terminating the Sea Grant Funding, because I think it is an important element, not only in the Maine/New Hampshire, but in the others that you described, as well.

Your budget, I gather, does not include all of your agency's related research. That is, there is research being conducted within the agency that extends beyond that down in your own division?

Mr. EHLER. That's right.

Senator MITCHELL. In the case of fisheries, do you know what the impact of the President's 1988 budget proposals will be on those research efforts?

Mr. EHLER. Well, I'm not familiar with the specifics, but I do know that considerable cuts are in store in 1988 for habitat conservation and for other fisheries programs, as well as cuts in other marine pollution-related activities within NOAA, including those within the National Marine Service.

Senator MITCHELL. Would you, Mr. Ehler, provide for this subcommittee, in writing, a summary of the proposed cuts and your assessment of what effect they would have on the research areas in each of the areas that are proposed to be reduced?

Mr. EHLER. I would be happy to do that.

Senator MITCHELL. I think that would be very helpful to the subcommittee in evaluating the proposals. There is, I think, some concern—apprehension—about what the effect would be, and I'd like to get your assessment, if I might.

Senator MITCHELL. Ms. Johnson, the Maine Audubon Society, among other things, has enacted a program of public education and information regarding natural resource issues. Do you believe there's an understanding throughout this State of the environmental and economic value of the Gulf of Maine?

Ms. JOHNSON. Yes, I do believe that that's true. The people of Maine are curious in wanting to associate their State with the ocean in almost an emotional way. They think of it as a wilderness, a wilderness frontier that they very much want to have stay that way. They may not want to go out and fish themselves, but they want to know that somebody can go out there and catch fish.

I'm not sure always that they're aware of what the impacts currently—impacts of civilization—are on the ocean, but they feel strongly that we should not be allowed, and that we should—almost at all costs they want to see the ocean preserved in its pristine condition.

Senator **Mitchell**. Mr. Ehler, you included in your statement considerable information regarding the results of some of the assessments made of various areas. You referred to the level of aromatic type of carbons in the sediments in Casco Bay, and I recognize that's data from just one site and only one year, and therefore it's not possible to draw meaningful general conclusions from that. What, in your judgment, does the data indicate about the need for further assessment, and what concern should there be about the health of these waters based upon that information?

Mr. **Ehler**. Well, it's assumed, in my oral as well as written testimony, there is—it's very important that we continue to watch these areas. Something is happening in Casco Bay, as well as in many other ports, harbors, and estuaries throughout the United States, and the objective of the Status and Trends Program is to systematically examine these areas over a long period of time so that we can get some determination of the current state, as well as long-term trends, of general conditions in these areas.

Throughout the United States estuaries are some of the most important areas that we have as a nation. They are truly a national resource. They are important, not only from an environmental standpoint, but also from an economic standpoint. So in every case where we find elevated concentrations we want to examine those areas in terms of long-run, and in some cases look at them in more detail in time and space whereby we concurrently sample these areas once a year for those areas where we find relatively high concentrations, and certainly it is important to do, perhaps with more frequency, at these areas—sample them more frequently, as well as sample them more intensely in terms of the number of samples taken.

Senator **Mitchell**. Well, is it fair to say that the findings reported, which you summarized in your statement, while they obviously ought to cause some concern and further assessment, are not, in themselves, sufficient to form any specific conclusions regarding the health of the Gulf and the areas involved?

Mr. **Ehler**. I certainly don't think that we can characterize the entire Gulf of Maine based on the very limited number of samples, as well as places that we have taken samples, in this area. It's something that has to be done in much more depth, not only by NOAA, but other institutions that have testified here today.

Senator **Mitchell**. Under the National Ocean Pollution Planning Act, it is NOAA that is charged with assessing and coordinating marine pollution research, development, and monitoring budgets of all Federal agencies. What has been the overall trend in Federal funding in that area in recent years?

Mr. **Ehler**. I hesitate to speak about the entire Federal Government. I think that it is true—certainly in NOAA's case—that we have had fewer resources with which to work. I think that that's probably a valid trend for the entire Federal Government, but I would like to submit the facts to you.

Senator **Mitchell**. I wish you would do that. I'd like to have you include the agencies which are covered by that broad grant of authority to NOAA in the Ocean Pollution Planning Act. In addition to the overall trend in Federal funding, what priorities for marine research have been identified at the Federal level? And in NOAA's latest review of fiscal year 1988 agency budget request, what kind of recommendations have been offered? I'd like to get that in writing at your earliest convenience to help this subcommittee.

Mr. **Ehler**. Senator, I'm sure you're aware that NOAA does prepare a Federal Marine Pollution Research Plan that does include those priorities, and each year it does account for dollars spent at the Federal level, so those are readily available and I will submit them to you.

Senator **Mitchell**. Thank you very much.

Thank you Mr. Ehler, and thank you Ms. Johnson, for your testimony. I appreciate it; it will be helpful to the subcommittee in determining the proper course of action in the future.

Mr. **Ehler**. Senator, may I add one correction?

Senator **Mitchell**. Sure.

Mr. **Ehler**. Not in my own testimony, but earlier Mr. Brennan made a statement that NOAA was transferring funds to the Environmental Protection Agency to carry out some programs. Well, let me assure you that that is not the case.

Senator **Mitchell**. All right.

Mr. **Ehler**. I've given the statement that I have prepared. We are not in any position to be providing funds to the EPA. I think what he was referring to was a $1 million transfer the EPA made to NOAA that was specifically identified in EPA appropriation to be spent on Long Island Sound. I think that's what he was referring to.

Senator **Mitchell**. Okay. Thank you very much, Mr. Ehler. Thank you, Ms. Johnson.

That completes the testimony of the scheduled witnesses. We've finished just a few minutes ahead of the time allotted for this hearing, so as I've done in other hearings of this type I'm going to ask if there's any member of the public who wishes to speak briefly on the subject matter of the hearing. If so, that person should come forward, identify himself or herself, and make whatever brief statement he or she wishes to make.

Ms. Johnson and Mr. Ehler, thank you. You may leave.

I'll ask if there is anyone who would like to say anything, any person who was not a scheduled witness, before we terminate the hearing.

One person stood up in the balcony quickly, and I don't know if she's making a fast exit or running down before we terminate the hearing, so I'll wait just a moment. No other person has sought to be recognized.

[Pause. No response.]

There is no one. All right.

Thank you all very much.

This hearing will be concluded, and we'll continue to work in this area, and look forward to working with those of you who appeared today, and other interested persons in the group.

Thank you very much.

[Whereupon, the hearing was concluded.]

[Statements submitted for the record follow:]

STATEMENT OF CHARLES S. YENTSCH

September 3, 1987

Senator George Mitchell
125 Forest Avenue
Portland, Maine 04101

Dear Senator Mitchell:

Thank you for the opportunity to address the Senate Subcommittee on Environmental Protection. When oceanography was an infant science in the United States, European scientists, who were world leaders, recognized the Gulf of Maine as one of the best studied areas in the western north Atlantic Ocean. This recognition was due to the efforts of Dr. Henry B. Bigelow. He focused his scientific talent - for a better part of thirty years - on the biology, chemistry and physics of the waters of the Gulf of Maine. As time has progressed we who work in this region have not had the opportunity to implement modern oceanographic investigations which would be the follow on to Bigelow's studies. It is true that the sustained importance of the Gulf of Maine fisheries has carried a need for analyzing fish stocks and associated environmental parameters; and more recently interest in mineral deposits off Georges Banks have prompt measurements of environmental parameters. Nevertheless the present day situation is that concerned scientists and agency administrators are relying on environmental information gained by Bigelow; largely fifty years ago. Meanwhile potential environmental problems have grown at an alarming rate. The scope of these environmental problems are regional; they involve three states as well as Canada.

The present status of our region is that the continued exploitation of the fisheries and developments along our coast are on a course a head on leading to collision. Industrial development throughout New England poses a threat to the environmental quality of the Gulf of Maine. There are numerous indicators at the local level that our water quality is changing; increased turbidity of the waters, appearance of red tide blooms, local regions of anoxia are all the early signs of a deteriorating environments. Because of the continuity of the water masses in the Gulf of Maine, solutions in terms of local conditions may be temporary at best or was misleading without having a full knowledge of background effects. There is no clear indication that any of the pressures on the coastal zones will lessen. One anticipates the potential for increases in sea level due to the development of hydroelectric sites in the northern regions of the Gulf of Maine; this increase will be in addition to an anticipated Global rise in sea level. Acid rain and acid Fogs are being augmented by eutrophication (Appendix I). The heavy trafficing of pleasure boats, oil transport and commercial fishing will continue to pose increasing environmental concerns.

Benefits of conducting environmental research should be seen as putting money in the bank. There are many precedences which exists to demonstrate that the cost of reversing undesirable situations is much greater than the amount needed to predict the outcome if certain actions are carried forward. The cost to benefit relationship argues that for a research effort in the Gulf of Maine the benefits accrued would service the needs concerned with: 1) the commercial harvest of fisheries; 2) the aquaculture industry; 3) the exploitation of mineral resources and 4) recreational activities.

Most present day research is ongoing within the Gulf of Maine occurs on an ad hoc basis. It is largely generated and supported by single investigator-type research grants obtained from specific agencies within the federal government. Within our laboratory there are on-going research programs which feature the use of satellites for estimating temperature and water color throughout the region. There are also programs that are investigating oceanographic features which are associated with larval fishes. There is a growing need for better environmental information for aquaculture projects specifically concerned with raising salmon as well as the rearing of mussels. These types of farmers are dependent upon basic information on water characteristics (temperature, flow etc.), and the appearance of toxic algae blooms, bottom conditions etc. They need this information prior to and before investment in sea farms. Discharges that are common to most industrial regions throughout the world are not uncommon to Maine. Many of our harbors already have toxic levels of chemicals, metals and pesticides. Their dispersion and inclusion into the marine food web is a primary concern to all who want to utilize the waters either for aquaculture commercial harvest or recreational activities. It seems almost farcical to mention that our state with chronic red tide problems has no sustained long term research program to combat the problem.

Scientists that are organized under ARGO-Maine belong to state of Maine institutions. They have the capability and expertise for carrying out long-term, large scale investigations in the entire region. The major obstacle is money money to carry out this activity. This program will require the the use of ships, satellites and instrumented buoy systems (Appendix II). Today we scientists utilize the Gulf of Maine as a laboratory for our individual specific research needs. What we recognize, as a group, that there are bigger concerns than our specific research efforts. We need now to focus on changes that are occurring in the total environment of the Gulf of Maine and get these changes wedded to the policy making decisions that regulate development of the resources (Appendix III). There is no funding mechanism to the federal system that we are aware of that would allow us the resources to support this program. The peer review system of the National Science Foundation would almost reject this concept because of "site specificity." The magnitude of the environmental concern is not to the level of being "catastrophic" hence agencies such as NOAA or EPA are not interested. Thus, concerned scientists in the area are essentially caught in the bind of knowing the need without the source of funding to satisfy this need.

I close by repeating that basic research on the Gulf of Maine is money in the bank. It can be demonstrated that such research will stimulate technical developments and improve industrial potential. This research will be needed by persons attempting to invest in either real estate (coastal lands) or real estate in coastal waters for aquaculture and commercial fisheries.

TESTIMONY TO THE SENATE SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

CHARLES S. YENTSCH
CHIEF EXECUTIVE DIRECTOR
BIGELOW LABORATORY FOR OCEAN SCIENCES
WEST BOOTHBAY HARBOR, MAINE

APPENDIX I

Senator Mitchell - -

Knowing of your interest in the acid rain problem I call your attention to the enclosed satellite image of the Gulf of Maine. The white area in the center is a bloom of a small microorganism which is highly reflective in sunlight. Note the size and extension of this bloom - - it convers one half of the entire Gulf.

The importance of this bloom is that this organism produces acid which becomes an aerosol and source for acid fogs and rain. Thus these organisms contribute to the overall problem. Our concern is that we know that introduction of nutrient fertilizers in coastal regions stimulates the growth of these organisms. Hence we are concerned as to the extent mans activities are aggravating the acid production problem by fertilizing the growth of these organisms.

APPENDIX II

TYPE OF STUDY

* WHOLE ECOSYSTEM

1) Climatological - Oceangraphic Project
2) Water Chemistry
3) Marine Biology (Planktonic, Benthos, Nekton)

* WHOLE ECOSYSTEM
NUMERICAL FLOW ANALYSIS

PARTICIPANTS

Department of Marine Resources
Bigelow Laboratory for Ocean Sciences
University of Maine
Bedford Institute of Oceanography
Dalhousie University

APPENDIX III

GULF OF MAINE STUDY

PURPOSE: To quantify principle physical-chemical mechanisms that regulate and distribute the marine biology; to model these for management purposes.

NEED: Management agencies concerned with regulating fisheries resources and water quality.

TESTIMONY OF
WILLIAM J. BRENNAN, COMMISSIONER
MAINE DEPARTMENT OF MARINE RESOURCES

BEFORE THE
UNITED STATES SENATE, SUBCOMMITTEE
ON ENVIRONMENTAL PROTECTION

PORTLAND, MAINE
September 8, 1987

Chairman Mitchell, Members of the Subcommittee on Environmental Protection, my name is William Brennan, Commissioner of the State of Maine Department of Marine Resources. My department is the principal executive state agency responsible for marine resource issues and I am pleased to appear before you today to present my perspective concerning environmental trends and the need for greater scientific research and monitoring in the Gulf of Maine.

The Department of Marine Resources engages, as the single, primary instrument of the state, in all aspects of marine resource research, development, management and enforcement. Our department is perhaps unique - at least on the Atlantic coast - in that our one agency maintains a coordinated program in all those state activities that relate to fisheries and living marine resources in general.

That is a large task, but one which gives us a unique comprehensive perspective on issues pertaining to our marine resources. Please note that I did not suggest that we possess a thorough understanding; rather one which in many respects reflects only the understanding that there is a multitude of influences on those resources. It is, in fact, that lack of a thorough understanding that brings all of us to this hearing today.

The department's mission is to "conserve and develop the marine and estuarine resources... to conduct...scientific research ... to develop... fishing industries... and to enforce the laws... necessary for... these purposes." This mission raises research, management, public health, and enforcement responsibilities to the forefront. I would like to briefly characterize our role in these areas.

The department's research must focus on those things relevant to understanding the species of importance to the state's fishery. I have provided for the record a copy of the department's 1986 annual research report to the Department of Marine Resources Advisory Council and to the State of Maine Legislature which will afford the committee with an overview of this agency's most recent research agenda.

A major purpose for which the department undertakes marine and fisheries research is our responsibility for resource management.

Such management systems must be based on the best scientific information available in order to be effective and have validity in the eyes of those most directly impacted by the terms of any given management program. However, in many fisheries, and certainly with respect to the resource and habitat as a whole, we are operating with only superficial knowledge. This is a major impediment to effective management.

The department undertakes management initiatives in three major areas: first is unilaterally as the state's fishery management agency for species under state jurisdiction; second through management programs implemented by the Atlantic States Marine Fisheries Commission, a compact of the eastern seaboard states; third through participation in the New England Fisheries Management Council, a public/private, multi-state body with responsibility for complex and sometimes controversial management plans for many Gulf of Maine species. Just as state action should be based on the best scientific information available, interjurisdictional Fisheries management must have the same basis. A basis which is not always available.

Another major departmental responsibility is monitoring and protecting the public health, a responsibility we share with other state executive agencies, such as the Department of Environmental Protection. Historically, the highest priority in this area has involved close scrutiny of the coastal waters in the context of the state's vast and popular shellfish resources. This continues to receive high priority. Beyond that focus, we have increasing interest in understanding the incidence and role of other possible contaminants in marine waters. The department also carries out a program of monitoring the condition of the various species found in coastal and marine waters. The fisheries pathological assessment unit continuously updates its information in this regard; of interest is the possibility of a relationship between environmental conditions and fish pathology.

The final department mandate pertinent to this hearing is enforcement. Suffice it to say that given the complexity of fisheries management, various conservation programs, protection of public health and more simply, the large area which must be surveyed, our enforcement responsibility is a major undertaking. One way to ease that burden is to assure that the rules and programs put into place are effective, meaningful, and based on the best understanding of facts possible. This brings us full circle to the need for focused, thorough, and insightful research into the systems upon which we impose these management programs. I would like to underscore that this applies to all public management and regulating bodies with responsibilities in the Gulf of Maine, both state and federal.

. . . .

My comments to this point have focused on what the state's marine resource agency does. I would like to focus now on the context in which those things are done: The Gulf of Maine its coastal waters, and the lands and rivers which bound and feed it.

The Gulf of Maine in 1986 yielded to Maine fisheries, products totalling 166 million pounds valued at 108 million dollars at the dock. Our sister states of New Hampshire and Massachusetts realized equally important contributions to their economies. The true value of this production is several times the landed value and should not be underestimated in the context of both employment and food.

The Gulf of Maine is considered by many to be a unique body of water, certainly in a scientific sense, but as a resource as well. It was characterized by Dr. Henry Bigelow, an early and important scientist, as

> "Partially enclosed by the Banks, Georges and Browns, that form its shallow offshore rim, and largely protected from the tropic water it faces by the peculiar distribution of densities along the arc of its seaward front, the Gulf is a sort of backwater from the Atlantic. Here...all the fish that makeup the 400-odd million pounds of seafood it yields to man every year play their roles, inured to seasonal fluctuations but seldom suffering any fatal variation in temperatures."
>
> "The Gulf may well be named a 'promised land' for its inhabitants; it is equable in climate and moderate in salinity; its deeps are constant from season to season; and it is well supplied with food..."

It is the conviction of many that the Gulf and coastal waters stand apart from other oceanic waters and must be treated as a whole much as other more easily definable bodies, such as the Chesapeake and Narragansett Bays are.

The coastal rim of the Gulf of Maine is an area of intense man-made and natural activity. The crescent from Cape Cod to Eastport, Maine, extends approximately 4,500 linear miles, with land use varying from some of New England's most mature urban areas, to fast growing Maine coastal communities, and finally, to areas of virtual wilderness. Population densities vary from 20,000 per square mile around Boston Harbor to an average of 184 per square mile or less on portions of Maine's coast. It is estimated that 75% of the U.S. population will live within 150 miles of the coast by the year 2,000. Clearly we are seeing this trend in New England. By way of example, coastal Maine population grew an average of 15% between 1970 and 1980, compared to 11% in non-coastal Maine. The western coast of Maine (from Kittery to Damariscotta) where 65% of the Maine coast population now resides, grew at rates between 20% to 30%. Moreover, population and development growth has shifted from an urban to exurban concentration. Including the Boston Harbor basin, this crescent also contains at least 10 major river watersheds draining major portions of New England. The interaction of these human and natural elements has the potential to affect the Gulf of Maine ecosystem profoundly and immediately as conflicts between them accelerate.

The fact that the Gulf has a unique integrity, lends additional importance to the fact that the influence the estuarine and riverine systems have on the Gulf must be considered as important as the biological systems of the Gulf. It becomes apparent, in fact that the interplay between the lands bordering the Gulf and the Gulf itself is a dynamic for which we have only an elemental understanding.

Let me characterize some of the indicators we are aware of with regard to environmental and ecologic concerns. The first is fairly graphic, yet its full impacts are not clear. On April 1 of this year, Maine experienced very significant flooding. In direct reaction to that event, my department necessarily closed a major portion of the coast to the harvesting of shellfish, given the risk and presence of bacterial contamination. That contamination is in reality only a physical representation of what are likely more profound impacts on the entire coastal ecosystem which will impact or are impacting, productivity in several important fisheries. We need to understand and be able to forecast that fact. Fishing historically has been a spontaneous activity. As the need to produce food grows, being able to forecast production becomes more important.

Other indicators of problems to come are reflected in the context of air pollution and acid rain. Polluted air drifts over the Gulf from the continental United States and Canada. It contains inorganic compounds and hydrocarbons produced by the burning of fossil fuels. At the air-sea interface, these contaminates mix with water vapour, and rain into the ocean. Their ecological effects are largely unstudied but warnings are clear. For example, inorganic nitrogen precipitated into surface waters in summer fertilizes the growth of phytoplankton and has been implicated as a cause of red tides and paralytic shellfish poisoning. There is good evidence that air pollution is the major source of polycyclic aromatic hydrocarbons (PAH) which occur in sediments in Penobscot and Casco Bays and in two deep basins offshore at concentrations typical of heavily industrialized areas. PAH concentrations in sediments and shellfish are directly and strongly correlated. The implications of PAH and other forms of airborne pollution for marine resources and public health must be studied now before they accumulatein the Gulf and we are left managing by crisis.

Acid rain/runoff is already a major concern for marine sports and commercial fisheries in Maine. Anadromous fish, such as salmon, which use rivers to spawn, are obviously affected. Less apparent perhaps but no less real may be the effects of acid water on marshes, estuaries and near-shore habitats. Acidity can alter the geological process by which mudflats are formed and the chemical processes by which suspended clays exchange nutrients with sea water. Although little studied, alteration of these processes could change the geographic distribution and productivity of clam flats and fishing areas. Acidity may also mobilize metal ions from sediments - ions which could be toxic to marine life. Metal ion concentrations are already high along some regions of the Maine coast because of naturally exposed rock formation.

The impact of these forms of pollution on marine resources in the Gulf of Miane cannot be separated from two important realities. 1) knowledge of short-term (years) and long-term (decades) natural fluctuations in populations of organisms is incomplete at best; 2) these forms of pollution perturbation interact among themselves and with natural sources of disturbance, such as bacteria, viruses, and storm erosion, to cause resources to fluctuate in abundance and distribution. The result is a set of scientifically complex problems which can be solved but only with a concerted multi-discipline approach which has a long-term financial commitment.

These events do not, in our estimation, suggest that a crisis is forthcoming. Rather they are byway of example only and are indicative of the need to further focus on the Gulf of Maine as a system. To address many of these concerns, the Department of Marine Resources has expanded its research activities beyond those bounds customarily thought of as the state's responsibiliy. The need to gain a fuller understanding has stretched our budgets and personnel capabilities to the limit, but at each juncture we find more questions than answers. From the perspective of this agency, and for other agencies, the capability to respond to and to anticipate the type of events mentioned above must be strengthened.

In my view, our management plans, be they fisheries related or public health related, should be based upon the best scientific information available. However, the best scientific information is not currently available because a concerted comprehensive program of multi-institutional, multi-disciplinary scientific research and monitoring in the Gulf of Maine is not in place.

Expanding the marine research partnership throughout the region (drawing upon the expertise found within our state, federal, private and academic institutions) is the only means of ensuring effective and productive management decisions regarding our use of and effect on the Gulf of Maine. It is these thoughts which have led the primary marine oriented institutions in Maine to create a consortium approach to focusing on issues. Representative of that consortium, the Association for Research in The Gulf of Maine, are on this panel today. To the state, this consortium represents a research effort that reinstates the traditon of fisheries research in the Gulf of Maine. It goes beyond the lists of flora and fauna and early descriptive and quantitative accounts of the Gulf. These original studies offer us a fairly comprehensive background on which to build, and ask the more basic questions: how does the Gulf work as an ecosystem?

We are seeing increasing pressure on our heretofore pristine Gulf. The human population along the coast is growing at an astronomical rate. Likewise, the fisheries are increasing to the point of overharvesting an otherwise sustainable resource. Only through research into the fundamental functioning of the Gulf, with a clear mandate to relate this to fisheries production, will we as a human population be able to continue to reap the aesthetic pleasures and fisheries resources the Gulf of Maine has to offer.

At this juncture, I would like to introduce into the record the statement of Mr. Walter Anderson, Director for the Maine Geological Survey of the Maine Department of Conservation. The purpose and expertise of the Geological Survey is an important part of the multi-disciplinary approach needed to address the problems cited above.

The existence of this consortium serves as an outstanding paradigm. The coincidence of it and the resource it focuses on are an occurrence which should be encouraged and utilized. It is that message, Mr. Chairman, that I hope to leave with the subcommittee today.

Thank you for the opportunity to participate.

DR. DALE W. LICK, PRESIDENT, UNIVERSITY OF MAINE

September 8, 1987 2 p.m. Portland, Maine

I appreciate the opportunity to outline the University of Maine's posture toward the Gulf of Maine.

The recent economic boom of New England has caused considerable demographic pressure on its oceanic boundary - the Gulf of Maine. The country at large is seeing a movement of people to the coastline, and we are experiencing this in-migration very acutely in Northern New England. Just as the native American population thousands of years ago turned its back on the resources of inland Maine and migrated to the intense productivity of the Maine coast, so are the new in-migrants to Maine displaying a distinct preference for the coastline. In a sense, the Gulf of Maine is being recolonized.

Simultaneously, basic attitudes toward lifestyles and the natural environment have undergone changes. Again common to the country at large, but particularly exemplified in Maine, is an increased valuation and respect for the environment and natural resources, particularly marine resources. The increased valuation of environment is expressed in legislation by increasingly tighter laws regarding environmental change and it is expressed in economic terms by land values in areas with marine exposure.

The Gulf of Maine, often described as one of the five richest and most productive marine areas on the planet, serves as the fountainhead of Maine's complex and longstanding relationship to the ocean. It has also become the focus of increased concern for the environment and natural resources, which must be balanced carefully with the economic bounty the Gulf represents.

Not only the environment itself, but the products which flow from it have become increasingly valued by our society. Fish prices have in recent years far outpaced the inflation rate. The Gulf of Maine offers the potential of becoming a marine breadbasket for the country similar to the midwestern and western agricultural development earlier in the century. The ongoing, intense harvest fishery of the Gulf is augmented by a tremendous potential for cold-water aquacultural products such as shellfish and salmon. Maine's proximity to urban centers, social concern for the nutritional value of seafood products, and modern transport systems in place both nationally and internationally, all point to an exciting future for marine produce.

What has not kept pace with this increasing societal valuation of the ocean and our sense of its promise has been our understanding of its workings. We are a society which, in its better moments, believes in meeting complex problems by seeking an understanding of their nature and then acting, with that understanding, in a rational manner.

Another, and more recent, development is the Maine Lobster Institute--a cooperative venture of the University of Maine and the lobster industry. Spawned in part by the Sea Grant program, this new Institute represents an attempt to provide powerful industry input into the research that members of that lobster industry have made clear is strongly needed. Its inception was partially guided by our successful analog with the forest products industry and the Pulp and Paper Foundation.

The Maine Lobster Institute is part of the University's Center for Marine Studies, and it is comprised of the Maine Lobstermen's Association, the Maine Lobster Pound Association and the Maine Lobster Import/Export Dealers Association. The Institute's initiatives are guided by a board of advisors drawn from the lobster industry and academic, government, and industry communities in the Northeast.

The Lobster Institute identifies practical problems of concern to the industry and seeks their solutions. Some of the solutions are found through quick-response projects. Others will require an increased understanding of the resource and will have to be reached through long-term research programs. By identifying the research priorities of the industry and providing industry assistance to researchers, the Institute links industry expertise with academic resources to promote a better understanding of the lobster and man's impact on it. The information found and generated is disseminated freely in a variety of ways.

These are examples of the ways in which the University of Maine carries out the research and public service aspects of its mandate as the Land Grant University and Sea Grant College of the State of Maine. They are conducted with deep commitment, efficiency and common sense.

But they are not enough.

Increasing pressures on the Gulf of Maine demand additional responses. We at Maine have explored those additional responses, and we are poised to act.

Marine ventures sponsored by the University interact with other organizations and agencies in the state with similar concerns about the marine environment. The mechanisms of these interactions include direct funding, policy advisory boards and overlapping memberships.

One major new mechanism for the University to expand its impact in this area is ARGO-Maine. While Governor Curtis will describe in greater detail the structure of this organization, let me add that ARGO-Maine will allow us to increase the effectiveness of our participation in Gulf of Maine research. The task at hand clearly requires far more resources than any one institution has available, and ARGO-Maine will aid in the research prioritization, coordination, and quality control that is necessary to successfully conduct any large program.

Recent legislation in Maine has made it clear that the coast is to enjoy more rational management, based in large part on an increased research effort. But the various governmental units responsible for the many aspects of management of the marine environment are without the understanding and data bases needed to carry out their mandates in a properly informed fashion. The Gulf of Maine is a relatively unperturbed part of the United States coastline, but to preserve its better qualities through rational management will require a priori understanding of those qualities.

Our society has a number of institutions to help in the enterprise of the first part of the solution to problems--the search for an understanding of the problems at hand. Some of the institutions represented in testimony today are involved in this task, and in this testimony I wish to show you that the infrastructure is in place to deal sensibly with the increasing pressures on the Gulf of Maine.

A major responsibility of our institutions and agencies is to create and disseminate knowledge in the services of the eventual user groups. Sometimes the connections and linkages between the science and the user groups is not obvious to either party. It is the job of the institutions to set up intermediating mechanisms which prevent science from focusing too far afield and which also keep the user groups educated about the need for the various levels of science. While basic research may often appear irrelevant to user groups, it provides the source for conceptual and technological advances at the applied level. And one responsibility of the research institutions is to clarify these essential linkages. Each of the institutions providing you with testimony today has its own mechanisms for this intermediation. Let me provide you with explanations of some of the mechanisms utilized by the University of Maine.

The Sea Grant Program, operated jointly between the University of Maine and the University of New Hampshire, conducts a variety of research and outreach programs. The gamut of research areas is wide, ranging from socio-economic studies to engineering projects to scientific topics. The problems chosen for research attention are so picked because of their relevance and timeliness. A tightly connected outreach program serves both to bring the results of this research to user groups throughout the region and to bring user group needs to the attention of scholars undertaking new research projects. This program has been highly effective in terms of the returns on dollars spent. This high rate of return has made the University of Maine/University of New Hampshire program one of the most highly regarded Sea Grant programs in the United States.

Nevertheless, the combination of a research budget of about $400,000 at the University of Maine and such a wide variety of research fields addressed, makes it simply impossible to mount the concerted effort needed to provide the basic environmental understanding of the Gulf of Maine. The basic oceanographic processes currently under study are an important component of the program, but only scratch the surface of the needs at hand.

The Sea Grant Program thus becomes a demonstration of the kind of productivity that can be achieved in our region, but not the answer to the problem of achieving a sufficient understanding of the workings of the Gulf of Maine. It simply cannot fund the large, long-term, multi-disciplinary and multi-institutional efforts of basic oceanographic research needed for the Gulf of Maine.

At the University of Maine, we have recently made a major commitment to the expansion of our marine sciences program. We stand ready to shift considerable and scarce salary resources to the hiring of marine scientists who can help in this venture. In particular, we have prioritised the hiring of faculty who are oriented toward basic environmental processes in the Gulf of Maine. The successful linkages being built with our colleagues in other organisations, through the agencies of ARGO-Maine and other mechanisms, will allow us most efficiently to build up an increasing firm scientific foundation in research and simultaneously avoid wasteful duplication of resources.

At the same time we are expanding our marine field station - the Ira C. Darling Center. This facility provides us with an exposure and access to the Gulf that will be critical in any future expansion of Gulf of Maine research.

One of the critical problems faced by organisations such as the University of Maine and other marine research institutions is the realisation that the phenomena we study, whether they are complex processes of the environment or the human interface with the environment, occur within long time periods. Trends take decades to develop, mature and give full expression of their characteristics. The funds with which we study these trends do not have the same long time periods. We have a clear and pressing need to develop a mechanism which will increase the time constants within which our marine research is conducted.

In closing, our institution, along with others engaged with similar missions, is increasingly prepared to serve our role in meeting the challenges to the Gulf of Maine. We have a large base of expertise available to perform the research needed, and the experience of tying this type of research to the needs of the community. We need only the resources to carry out the work in this rapidly changing region. The understandings that we develop will provide not only the underpinnings for a rational response to the recolonisation of the Gulf of Maine, but also serve as a strong contributor to the similar responses that must be mounted throughout the country.

Thank you.

TESTIMONY BY KENNETH M. CURTIS
ON BEHALF OF THE ASSOCIATION FOR RESEARCH ON THE GULF OF MAINE (ARGO-Maine)
TO THE SENATE SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

The State of Maine is blessed with seemingly limitless natural resources in the waters beyond its picturesque and winding coastline, resources that have for centuries yielded a bountiful fishery and helped to fashion a way of life for which Maine is now famous. But unfortunately these natural resources are not limitless, and as has been plainly demonstrated in other parts of the coastal United States, they can be driven to the point of severe depletion and decimation--often for the want of a clearer understanding of how to manage such a complex marine system. Often this realization comes too late; and, the task then becomes one of recovery rather than preservation. Few would argue that the Gulf of Maine is of immense value to the economy of New England and the livelihood of its citizens.

It is even more critical to the State of Maine, whose two principal natural resources are its forests and its oceans.

What happens in the offshore waters of the Gulf of Maine impacts on virtually every aspect of the coastline.

Given our dependence upon this vital resource it is a great cause of alarm that we must admit that our present scientific understanding of the processes which control it remains at only a rudimentary level. And while the Gulf as a whole may seem to stand out as a fine example of a pristine body of water, we must face the reality that it is just as vulnerable as America's other coastal environments that today face enormous cleanup efforts, efforts that might just as well have been averted had we taken the time to understand those processes which are by all appearances very easily smothered.

The health of the Gulf of Maine 10 years or 50 years from now need not mock that of such bodies of water as Chesapeake Bay, which has succumbed to unchecked demographic stresses that have impacted the bay in ways that scientists are only now beginning to understand. In fact the resiliency of the Gulf of Maine to withstand the impact of human activities thus far is by all outward appearances remarkable, and the continually increasing exploitation of its natural resources have not yet posed sufficient threat to the entire system to raise the crisis situation we so often await before taking action. But

isolated problems are beginning to attract public attention--unfortunately, our present scientific knowledge of the Gulf is woefully inadequate to come to grips with these growing and potentially serious problems. Owing to this lack of a solid scientific foundation the answers to straightforward questions are more likely to be judgmental rather than explicit.
And while science alone can never provide all of the answers to these and other complex socio-economic questions, a sound scientific basis for resource management decisions would be a major improvement in the decision making process. Though growing pressures on the Gulf of Maine could indeed mirror those of the Chesapeake, we must pursue a course of prudent management, based on solid scientific facts, as our best hope for preservation.

Much of our present knowledge of the processes operating in the Gulf of Maine stems from the early pioneering works of Henry Bigelow and others which were carried out during the first half of this century. More recent studies have been directed toward specific problems with less broadly defined objectives, and although the quality of these later efforts has often been excellent, and should continue, they have done little to further our understanding of the processes affecting the Gulf of Maine ecosystem as a whole. Questions which beg answers today are many and varied, and encompass virtually all disciplines of oceanography and marine science. And while advances on many scientific fronts have been made in the last two decades, we still have only the crudest models for interpreting and predicting the processes operating in coastal marine ecosystems such as the Gulf of Maine. Until a planned and coordinated effort is mounted, progress in understanding will be slow.

It is ironic that research conducted decades ago is still considered in many ways to be the most definitive for the Gulf of Maine. Yet the last few years have witnessed an explosion in technology which facilitates the rapid acquisition and assimilation of enormous amounts of data. Ocean scientists now have available to them the ability to measure ocean parameters on a level that would have Bigelow and his colleagues reeling. We stand at the threshold of applying these modern technological marvels to our own Gulf of Maine - from earth-orbiting satellites which can observe oceanographic processes from space, to flow cytometers, which examine the properties of individual microscopic plankton cells at a rate of 20,000 per second. But random application of these powerful tools to the Gulf ecosystem will not in and of itself guarantee success. What is needed most of all is a planned, well-coordinated approach to this research effort.

Maine scientists , and most recently, the Maine Maritime Academy, recognizing the need for such a coordinated research initiative, have joined in an association to form a critical mass of scientific and marine expertise, committed to studying and preserving the Gulf of Maine in a whole ecosystem approach.

This consortium is known as the Association for Research on the Gulf of Maine, or ARGO for short.

Its members are the University of Maine, the Maine Department of Marine Resources, Bigelow Laboratory for Ocean Sciences, the Maine Geological Survey and Maine Maritime Academy.

The State of Maine itself has in these institutions a large number of highly qualified and recognized scientists.

By joining together as a group this capability will, through ARGO, be channeled towards the Gulf of Maine in a manner that will have maximum impact.

ARGO stands ready to mesh information from oceanographic and climatological observations with features of water chemistry and marine biology in an effort to understand the intricacies of the myriad factors ultimately controlling the health and well-being of the Gulf of Maine and our nation's coastal waters in general. Such a research initiative, which takes full advantage of modern oceanographic technology, is sorely needed if we are to make intelligent decisions concerning man's future interactions with our country's precious coastal resources.

The operative words above are--coordinate, mesh, whole ecosystem, and critical mass. If basic scientific research is to take its proper place in the public business and governmental processes being applied to coastal ecosystems, then the tenets of institutional cooperation, planned research, large scale research projects and the like must be adopted by our marine community.

It is clear that solving the problems facing our coastal areas can be most efficiently accomplished by a concerted, interdisciplinary attack involving many institutions. Individual projects conceived according to the perceptions of individual investigators will bring us closer to our goal, but one or a few major research programs, conceived by an organized group of scientists, will serve as the core effort to bring us more efficiently to an holistic understanding of the Gulf of Maine as a model coastal ecosystem. It is for this reason that the Maine institutions mentioned above have formed ARGO-Maine to plan and instigate a long-term program for research on the Gulf of Maine. Applied scientists within the State's Department of Marine Resources and the Maine Geological Survey are well equipped to form a solid foundation upon which marine scientists from the University of Maine and Bigelow Laboratory can bridge the gap between the often recondite, yet vital researches of basic science and the pragmatic technological issues facing the users of Maine's coastal and offshore waters. ARGO-Maine's most recent member, the Maine Maritime Academy, and Maine's awarding of a well-equipped research vessel by the National Science Foundation, to be operated by Maine Maritime Academy, solidifies the framework for research to move forward.

In spite of the rich Gulf of Maine resource this is the first deep sea research vessel to be stationed north of Cape Cod.

Maine's strong cadre of scientists now have the capability to devote off shore research activities on a year round basis.

The ARGO-Maine initiative has already gained support from the Maine legislature in the form of operational monies for this newly acquired research vessel, but this is only a beginning.

Scientists will require additional assistance if we undertake the wise management of our coastal resources.

It is our belief that a research program on the order of a decade in length can provide answers to the questions alluded to above and detailed in earlier testimony. Furthermore, the answers must be sufficient in form and substance to provide a more rational base for environmental and fisheries management policy decisions than exists today--in the Gulf of Maine and in coastal ecosystems in general. We emphasize that such a program would not in itself provide a complete understanding of the Gulf of Maine ecosystem--such an enormous task would require far more resources than are available presently. However, in concert with other basic research continuing throughout the oceanographic community and in our own institutions, we could provide the necessary site-specific information that would represent the next quantum leap beyond the pioneering work of Bigelow and his colleagues and in so doing lay the very foundation for similar concerted research efforts around the country--perhaps before yet another coastal ecosystem becomes a shame rather than a treasure.

The people of Maine recognize that the Gulf of Maine is a precious resource which must be understood properly by those living at its edge. The responsibility for reaching this goal must be shouldered by the marine science community through a commitment to excellence in both basic and applied marine research, and reflected by a well-planned and competently directed research and monitoring program of the highest caliber. The ARGO-Maine institutions recognize this need, but the job facing us is rapidly out running our present capabilities and new resources from the Federal government are needed. Other states with coastal waters have mounted ambitious programs for studying and protecting their ocean resources--often when it is already too late. Maine has been slow to recognize the need to maintain and protect the quality of the Gulf of Maine through a research and monitoring program in keeping with the finest technology available today. We may have been slow, but luckily we are not too late.

It is far more prudent to expend the lesser financial resources now to preserve this coastal resource rather than that of following the sad course of expending far greater sums after it is too late.

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STATEMENT OF
JEFF KAELIN, EXECUTIVE DIRECTOR
MAINE SARDINE COUNCIL

BEFORE THE
SENATE SUBCOMMITTEE ON ENVIRONMENTAL PROTECTION

ON

MARINE RESEARCH ISSUES IN THE GULF OF MAINE

SENATOR GEORGE J. MITCHELL, CHAIR

PORTLAND CITY HALL
PORTLAND, MAINE
SEPTEMBER 8, 1987

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Good afternoon, Senator Mitchell. I am Jeff Kaelin, Executive Director of the Maine Sardine Council whose offices are located in Brewer. I am also a member of the Department of Marine Resources Advisory Council, Vice President of the Associated Fisheries of Maine and a member of the University of Maine/University of New Hampshire Sea Grant Policy Advisory Committee. In all of these capacities, the issues of the environmental integrity and production of the Gulf of Maine, along with the adequacy of the research efforts directed towards a better understanding of the Gulf of Maine, are extremely important.

I want to preface my remarks by saying that I am pleased that you and the Subcommittee on Environmental Protection have chosen to conduct this hearing to focus on one of Maine's greatest natural resources. I also want to thank you for the opportunity to be here today.

The potential for the irreversible contamination of our air, water and food supplies through the careless use of industrial and domestic materials and processes is a major issue today. I am convinced, however that we can reduce this threat and stop the decline in the health of our coastal and estuarine areas by continuing, and building upon, existing research and monitoring programs as we develop the collective will to insure the future productivity of our renewable ocean resources. Your assistance is greatly appreciated.

In Maine, we are fortunate that our coastal areas remain productive and clean. The National Oceanic and Atmospheric Administration's National Status and Trends Program for Marine Environmental Quality has identified the Casco Bay and Machias Bay areas as being very clean and uncontaminated in comparison to many other coastal areas of the country.

I believe that continuing a national monitoring and assessment program such as this one is essential to protecting the Gulf of Maine and our coastal region from additional contamination and a possible, resulting loss in the availability of our renewable fish and shellfish resources.

While research designed to identify and quantify contaminants in our ocean and coastal environment should continue to be a national and a state priority, we must also develop the capability to determine the actual health risks associated with various levels of contamination. To paraphrase a statement attributed recently to a General Mills food scientist, "Our ability to detect has far exceeded our ability to interpret.".

This fact is extremely important to the interests of both those who produce food from the sea and those who consume these products. Inflammatory reports like that of the Coast Alliances' "Contamination of New England's Fish and Shellfish", released this June, are of great concern to us. With no evidence to support statements such as " ... a trip to the fish store (is like) a game of Russian roulette" this type of reporting is all too prevalent today. We need facts, not fears to insure a wholesome food supply and avoid marketplace hysteria. Rational, scientific conclusions and dollars for research into the prevalence and effect of contaminants in the ocean environment are prescriptions for avoiding a seafood marketing disaster without cause.

A second area which must remain both a national and a state marine research priority concerns the continued funding of research in support of fisheries management. The fishery management system which has evolved from the passage of the Fishery Conservation and Management Act in 1976 is a sound one. The process is benefitting from the serious efforts of many commercial fishing interests who are committed to working with the federal and state governments to conservatively manage our fisheries resources. The Regional Council system must be supported and maintained to further enhance the role that fishing industry members are playing in protecting their ability to stay in business over the long run, by insuring the continued viability of the stocks they depend upon.

Wise fishery management decisions can only be made with sound scientific knowledge, however. The funding cutbacks which the National Marine Fisheries Service and the grants-to-states programs (particularly the recently overhauled Interjurisdictional Fisheries Research Act) have had to endure over the last several years have directly translated into less adequate resource information from which to make sound management decisions.

It is far less costly to government decision makers to limit fishing effort and opportunities on the basis of inadequate resource strength than it is to put time and effort into adequate scientific assessments of stock abundances. Money has to be found and made available for abundant research of this nature, not only to protect our fisheries resources but also to encourage the participation of the fishing industry in the management process. Without industry cooperation, our fisheries management system can not be successful in conserving our fisheries resources in the interest of maximizing our economic returns from them.

Here in Maine, inadequate scientific information on the abundance of the region's herring resource has created a significant controversy over a recent allocation of fish to a foreign factory vessel. Because dollars for research into the abundance of fishery stocks in the region are limited, there has not been an assessment of the year class composition of the herring stock -- an index important to determining a stock's maximum sustainable yield -- in several years. It is impossible to make reliable allocation decisions without reliable information.

Several research programs focusing on Maine's herring resource are ongoing, however, but research dollars remain inadequate. Department of Marine Resource scientists are examining larval populations and egg bed habitats to try to anticipate annual recruitment into Maine's herring fishery.

Surveys of brit populations (one year old fish too young to be harvested) are being conducted by a team of Maine and Canadian scientists onboard a Canadian research vessel this summer and fall during the second of a three-year project being funded by the state, the National Marine Fisheries Service and the Canadian Department of Fisheries and Oceans.

One aspect of this bilateral project utilized an experimental hydroacoustic technology to assist in assessing the viability of the area's herring stock. A modest industry grant was awarded recently by the Maine Sardine Council to assist this project in order to encourage the development of a more informed estimate of the resource's strength.

While I believe that industry contributions for research in support of management are important and should be encouraged, I do not believe that industry funds alone would generate sufficient marine research to answer even a small number of fisheries management questions.

Continued federal support for fisheries-related, applied and basic research projects through the National Marine Fisheries Service, the National Sea Grant College Program and the grants-to-states programs are vital to expanding our understanding of the dynamics of fisheries recruitment, fishing pressure, predation and changing climatological and oceanographic phenomenon. The expenditure of public money for this purpose is justified by the significant economic returns which our fishing industry generates in our coastal economies and by the benefits the nation's seafood consumers receive from an abundant supply of wholesome seafood products.

Finally, before I close, I want to mention an area of marine research policy which deserves refocused federal attention and is scheduled to be reauthorized next year -- the Marine Mammal Protection Act. While the protection of viable populations of marine mammals may be a laudable goal, the Marine Mammal Protection Act's "maximum sustainable population" standard seems to be at cross purposes to the Fishery Conservation and Management Act's "maximum sustainable yield" concept. While fishing pressure is being regulated to maximize the viability of managed fish stocks -- often with significant costs to industry participants -- burgeoning marine mammal populations are suspected of consuming large volumes of seafood which could be allocated to humans. I am not advocating a wholesale slaughter of marine mammals but I am advocating a marine mammal policy that is no less management oriented in relationship to marine mammal populations than our fishing management policy is in relationship to fishing industry participants.

This change in emphasis would require more research into predation as an aspect of fisheries management policy. The penalties which stem from the Marine Mammal Protection Act's absolute protection goal will continue to significantly hamper efforts to focus on the predation variable in the fisheries management equation if changes in the Act are not forthcoming.

As we endeavor to understand the productivity and complex relationships of the ocean ecosystem, wise management policies and studied scientific conclusions -- not protectionist policies or pseudo-science in support of political agendas -- will provide us with the greatest long-term economic benefits from our coastal resources. Adequate research efforts are essential to that success.

Thank you for the opportunity to share our views with you today. We look forward to continuing to work with you and your staff and with the other members of our Congressional Delegation to insure that the sustained productivity of the Gulf of Maine will play an important part in our state's future well-being. I will try to answer any questions you may have for me.

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MAINE AUDUBON SOCIETY
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The responsible voice for Maine's environment and natural resources.

Senator Mitchell, my name is Anne Johnson. I am Director of Marine Programs for the Maine Audubon Society. Maine Audubon is committed to conserving Maine's natural resources through research, education and advocacy, and has recently launched a program directed at protecting and enhancing the ecological integrity of Maine's marine environment. Before coming to Maine Audubon, I worked with Peter Larsen at the Bigelow Laboratory on several pollution related studies. These studies have, in part, helped to raise concern about environmental degradation in the Gulf of Maine that has culminated in today's hearing.

Reports of pollutant accumulation in the Gulf of Maine can be viewed as good news for Maine. Good news because they indicate that Maine does not suffer from the serious problems facing places such as Boston and New Bedford. Good news because awareness of a pollution problem in its very early stages greatly increases the likelihood that measures can be taken to protect our invaluable marine environment.

These reports should serve as an early warning signal to the Federal Government, the State, fishermen, scientists and the environmental community. Now is the time to address the problem, to ward off potential degradation of the Gulf ecosystem and concomitant economic hardship. It is our responsibility, as stewards of the environment, to take appropriate action to safeguard the ecological integrity of the Gulf of Maine.

Environmental Trends

Hydrocarbons, trace metals and some synthetic organic contaminants are accumulating in the sediments of the major embayments of the Gulf of Maine. In some cases, concentrations are similar to those found in more heavily industrialized areas. Little of the contamination found in Maine waters is the result of tanker spills or industrial accidents. Rather, the chronic input over time of lesser, sometimes undetectable, amounts of contaminants, is responsible for much of our marine pollution. Point sources, such as sewage treatment discharges and industrial outflows, make up a portion of the pollution load reaching coastal waters; however, non-point sources such as urban storm water runoff and watershed erosion are also major contributors to coastal contamination. Non-point pollution is comprised largely of combustion products released to the atmosphere from vehicles, smoke stacks, wood stoves and furnaces. Soot particulates contain polycyclic aromatic hydrocarbons (PAHs), trace metals and other potentially toxic compounds and can be transported down wind for hundreds of miles before falling back to earth. After deposition they are eventually washed into the ocean in a slow but steady stream. Contrary to the popular conception that pollution dissipates in an almost infinitely large ocean, these particulates settle out near their point of introduction to the marine environment. While water column analysis may reveal little or no pollution, contaminants are slowly accumulating in nearshore sediments. It is hypothesized that long-range transport and deposition may account for the surprisingly high level of PAHs found in Penobscot Bay sediments in 1982. Clearly, we in Maine are dealing with a problem not solely of our own making.

I do not believe that PAHs or trace metals in the Gulf of Maine currently pose a threat to public health; however, I am concerned that they may be adversely affecting the environmental health of the Gulf. Analysis of data collected in our baseline survey of Penobscot Bay sediments revealed a correlation between PAH concentrations and changes in faunal community structure. While further research will be needed to prove cause and effect, the implication is that PAHs are affecting the structure and function of the benthos. The benthos is an integral part of the marine ecosystem: as the sink for detritus it is the point of nutrient renewal and the basis of the detritus food chain; it is a useful indicator of environmental health. Pollution correlated changes in the benthos may indicate that the larger marine ecosystem, including fish stocks, may be at risk. The greatest risk for Maine's fisheries is not concern for public health (founded or unfounded) but rather the negative impact of contaminants on fish productivity. While concern for public health must be paramount, I believe that by protecting environmental health we also protect public health and, in the long run, the health of our marine resource based economy.

Current Programs

Existing data on pollution impacts in the Gulf of Maine have not resulted from a comprehensive program but rather from a small number of unrelated projects with varying objectives, timetables and resources. In the early '80's, NOAA's Northeast Monitoring Program provided funds for our baseline surveys of Penobscot and Casco Bays. That program was scrapped in favor of the current Status and Trends program which regularly samples only one or two stations in Maine as part of a nationwide program. A variety of research projects funded by Sea Grant, NSF, and other agencies, and conducted by the University and other groups has provided limited data on pollution impacts in the Gulf. The Army Corps of Engineers provides some data on sediment concentrations as a result of its requirement that potential dredge spoils be analyzed for contaminants.

Maine's marine waters were recently classified. The classification process is goal oriented; however, there has been no sampling to assess how closely such goals are being met. In fact, there is little or no data on water quality for most of the Maine coast. The only regular sampling of Maine's marine environment is conducted by the Maine Department of Marine Resources (MDMR) to protect consumers of shellfish from the ill effects of red tide and domestic sewage. There is no consistent program to monitor sediments or organisms for toxic compounds such as hydrocarbons, trace metals or synthetic organics to protect either public or environmental health.

To rectify this situation, the Maine Department of Environmental Protection (MDEP) has recently started a new marine monitoring program. Pilot sampling was carried out at one site last year. Lack of funds has jeopardized the planned expansion of this program to an additional four sites this year. At this point, the program has more value as an educational tool in raising awareness of the marine pollution issue than in addressing the nature of the problem.

While the recent Coast Alliance report may have exaggerated the risk to consumers of eating Maine seafood, reaction to the inflammatory portions of the report overshadowed some very legitimate conclusions of the study: neither Maine nor the Federal Government has any significant, comprehensive program for assessing the health of Maine's marine ecosystem.

Federal Involvement

The Federal Government can play a role in protecting the environmental quality of the Gulf of Maine in five areas: (1) funding for research and monitoring programs, (2) technical support, (3) development of regulatory standards and guidelines, (4) coordination and oversight, and (5) focus on preventative measures.

(1) In order to protect the Gulf we need to know more about it. Funding is needed for research on:

* methods to differentiate pollutant impact from natural variability,

* the role of airborne deposition in the contamination of coastal waterways,

* predictive modelling of the fate of contaminants in a complex marine ecosystem,

* the role of estuaries and salt marshes in the productivity of the coastal ecosystem, and

* the role of these same habitats in fish population ecology.

Argo Maine and other members of Maine's marine research community are well suited to pursuing these and other research goals. This group is responsible for much of the significant research conducted in the Gulf to date and has a reputation for excellence. Clearly, Maine's scientists are best suited for addressing research needs in protecting the Gulf. A consistent, long-term source of funding would allow these researchers to initiate a significant investigation on the health of the Gulf.

While research will provide us information on mechanisms of pollutant transport and impact, monitoring plays a complementary role by specifying the nature and extent of contamination. Research and monitoring together will provide a picture of the risk to the Gulf from pollution. Monitoring programs:

* determine baselines,
* assess changes in contaminant concentrations over time,
* identify "hot spots", and
* correlate contaminant concentrations with changes in community structure or productivity.

Such programs are an appropriate function of state government. Federal funding would facilitate the establishment of a significant monitoring program in Maine.

(2) A federally funded sample processing facility, perhaps serving a multi-state region, would standardize results, assure quality control and reduce the burden on state laboratories and resources of processing large numbers of samples.

(3) Regulatory activity on the part of the Federal Government can also foster protection of the coastal and offshore environments. Federal regulations played a major role in the recent enactment of significant, pollution control legislation in Maine, which banned new overboard discharges of residential sewage. Because of strict standards imposed on the interstate shipment of shellfish by the FDA, MDMR must carefully monitor shellfish areas for indications of sewage pollution; closing those areas to digging that do not meet the standard. As a

result of this program, roughly one quarter of Maine's mussel and clam flats are off limits to most diggers. In the face of increasing demands for sewage discharge, and the concomitant loss of income for shellfish harvesters, these federally imposed standards provided the incentive for the Legislature to vote to outlaw all new discharges. The promulgation of similar regulations regarding other contaminants would provide incentive for additional discharge prohibitions. The development of sediment quality standards to complement existing water quality standards would greatly increase the effectiveness of state and federal permitting procedures in identifying potentially harmful discharges. Such regulations, expanded to protect environmental as well as public health, would do much to reduce point source pollution.

(4) The Federal Government can play a vital role in the oversight and coordination of research and monitoring programs in the Gulf of Maine by:

* coordinating and promoting the participation of state, federal and provincial governments in efforts to protect the Gulf,

* establishing a standardized sampling protocol for monitoring programs, and

* integrating efforts of different organizations to insure compatibility and usefulness of the data.

(5) As a major objective, a research program for the Gulf of Maine must answer the resource manager's question: "what can we do to protect marine environmental quality?" It is not enough to collect data on the extent and effects of contaminants in the marine environment; research questions must be guided by the need for preventive action. Furthermore, we do not have the luxury of waiting until all the research

questions are answered before taking preventative action. Preventative measures such as review of watershed land use practices and discharge permitting procedures should be undertaken immediately. The effectiveness of such programs will be improved as information from research and monitoring is generated. As a condition of funding, the Federal Government can impose a set of objectives on the proposed program to insure its relevance to the overriding goal of protecting environmental quality in the Gulf of Maine.

In conclusion, I thank you for the opportunity to express our views on this timely and important issue.

Hearing on Environmental Trends and Scientific Research and Monitoring in the Gulf of Maine

Statement of
Charles N. Ehler
Director
Office of Oceanography and Marine Assessment
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Before the

Subcommittee on Environmental Protection
Committee on Environment and Public Works
United States Senate

September 8, 1987

Mr. Chairman and Members of the Subcommittee:

I am Charles N. Ehler, Director of NOAA's Office of Oceanography and Marine Assessment within the National Ocean Service. Accompanying me today is Dr. Robert Murchelano of NOAA's Northeast Fisheries Center, within the National Marine Fisheries Service. Dr. Murchelano is the Chief of the Environmental Processes Division at the Northeast Fisheries Center and an expert on the effects of pollutants on fish.

I am pleased to summarize our current assessment of environmental quality conditions in the Gulf of Maine and to describe NOAA research and monitoring programs that are relevant to this hearing.

The Gulf of Maine Marine Environment

The Gulf of Maine area of the continental shelf is part of the North American Atlantic continental margin that extends from the Straits of Florida in the southwest to beyond the Grand Banks of Newfoundland in the northeast. The geomorphology, or the shape of the sea floor, of the Gulf of Maine area consists of banks and ledges, together with shallow depressions known as basins, and a channel that marks a significant break in the surface of the continental shelf. The four principal geomorphological features in the Gulf of Maine area are the Northeast Channel, Georges Bank, the Scotian Shelf, and the Gulf of Maine Basin. The Gulf of Maine Basin, a large rectangular depression with an area of approximately 21,430 square nautical miles (74,180 square kilometers) and an average depth of about 500 feet (150 meters) is landward of Georges Bank and west of the Scotian Shelf. On the floor of the Gulf of Maine Basin are many small basins, separated by ridges, ledges, and knolls. The irregular surface was caused primarily by rivers and glaciers that traversed the area when it was dry land, and eroded the softer sedimentary rocks more deeply than the harder rocks.

The marine environment of the Gulf of Maine is characterized by three principal ecological regimes: the Gulf of Maine Basin; Georges Bank; and the Scotian Shelf. These identifiable ecological regimes play a major role in determining the distribution and abundance of commercial fish and shellfish in the Gulf of Maine area. The geomorphological features of the three principal ecological regimes in the Gulf of Maine area, together with the Northeast Channel, largely determine the circulation patterns of the overlying waters. The circulation patterns and other physical characteristics of the overlying waters, in turn, largely shape the communities of flora and fauna within them.

The water flowing over the Scotian Shelf comes from the Gulf of St. Lawrence and the subarctic region to the north. It flows generally southwestward over the Shelf, parallel to the Nova Scotia peninsula. Some of this water continues southwestward seaward of the continental shelf. The remainder curves around Cape Sable, with a portion of it forming a clockwise gyre over Browns Bank, and the bulk of it feeding into the surface waters of the Gulf of Maine Basin and the Bay of Fundy. Water also flows rapidly into the bottom of the Gulf of Maine Basin through the Northeast Channel. This water, which originates seaward of the continental shelf, is highly saline. As it fills the bottom of the Basin, it lifts the upper, less saline, and therefore less dense, layers of water. Within the Basin, the water moves in a complex counterclockwise gyre. Water moves from the Gulf of Maine Basin to Georges Bank in a variety of ways. Surface water spins out of the gyre in the Gulf of Maine Basin and flows onto Georges Bank. In addition, water wells upward onto Georges Bank from the depths of the Gulf of Maine Basin.

The waters of the Gulf of Maine Basin reach depths of approximately 1200 feet (377 meters). The water entering the surface of the Gulf of Maine Basin from the Scotian Shelf is relatively low in salinity, while the water entering the bottom of the Basin through the Northeast Channel is highly saline and rich in nutrients. The bottom water remains relatively constant in temperature through the year, while the surface water varies greatly in temperature seasonally. During the winter, the surface water cools and tends to sink; consequently, the top 500 to 650 feet (150 to 200 meters) of the water column are mixed vertically. Salt and nutrients from the deeper water are mixed into the rest of the water column at this time. During the spring and summer, the water in the Gulf of Maine Basin is more stratified because the surface waters are warmed by the sun, while the inflow through the Northeast Channel continues to maintain the temperature of the bottom layer. Between the surface and the bottom waters, a cold intermediate layer, a remnant of the winter cooling, remains and slowly dissipates through the summer.

The Living Resources of the Gulf of Maine

The distribution and abundance of phytoplankton and zooplankton, the initial links in the marine food chain, determine to a large extent the location of other species, including commercial fish and shellfish. Phytoplankton are food for herbivorous (plant-eating) organisms, including zooplankton, larval fish, larval benthos, some adult fish, and many adult benthos. Phytoplankton are transported passively by water currents. Their distribution is not uniform and reflects circulation associated with the counterclockwise gyre in the Gulf of Maine Basin and over the clockwise gyres in Georges Bank and Browns Bank.

Like all plants, phytoplankton need light and nutrients to grow. They are most abundant in shallow, well-mixed waters, where nutrients on the bottom are churned upward and reach the sunlit surface waters. In the Gulf of Maine this occurs in the well-mixed waters along the coast, in the mouth of the Bay of Fundy, and over Georges Bank. Phytoplankton are not plentiful in the Northeast Channel or in the center of the Gulf of Maine Basin. Zooplankton congregate in areas with high concentrations of phytoplankton. Like phytoplankton, they are usually kept in the Gulf of Maine Basin by its counterclockwise gyre.

Benthos, or bottom-dwelling organisms, are an important source of food for fish. This includes organisms such as starfish, worms, snails, sponges, barnacles, crabs, lobsters, and scallops. Differences among benthic communities are determined to a large extent by variations in bottom sediment, water temperature, and phytoplankton production. The Gulf of Maine Basin consists largely of silts and muds. Benthos inhabiting the Basin include brittle stars, sea urchins, sea squirts, and tube-dwelling worms.

Approximately 200 species of fish and shellfish can be found in the Gulf of Maine area, of which 40 to 50 species are of commercial significance. Total effort in the Gulf of Maine otter trawl fisheries increased nearly two-fold since the enactment of the Magnuson Fishery Conservation and Management Act (Pub. L. No. 94-265), reaching an all-time record in 1986. Effort in the gill net fishery, however, has remained relatively constant over this period. Since 1976, trawl effort by small boats (less than 50 gross registered tons) has remained relatively stable over time, but has increased by 183% for medium-sized vessels (51-150 gross registered tons), and by over 400% for large vessels (greater than 151 gross registered tons).

Catch-per-day-fished has declined sharply as abundance of traditional species such as redfish, cod, and flounders has declined and effort has increased. The decline in otter trawl catches of these species has been partially offset by increased landings of lower-valued species such as pollock and silver hake. Fisheries in the Gulf of Maine are directed towards 12 species that comprise approximately 70-80% of the total catch.

In 1986, the major species taken in commercial fishing operations in the Gulf of Maine and their contributions to the total Gulf of Maine catch were: Atlantic herring (25%); pollock (15%); Atlantic cod (8%); American lobster (7%); silver hake (6%); American plaice and witch flounder (5%); cusk, white hake, and wolffish (5%);northern shrimp (4%) and redfish (2%). A brief synopsis of the current status of these species follows:

Atlantic herring catches from coastal Maine locations dropped from about 48,000 tons in 1981 (the highest since 1963) to 16,000 tons in 1986. Western Gulf of Maine catches were about 16,000 tons in 1986. Stock biomass in the Gulf of Maine declined 37% from 1979 to 1982 to 134,000 tons, the lowest stock level yet observed;

Pollock landings from the Gulf of Maine portion of the stock have doubled since the late 1970s from about 12,000 tons to 24,000 tons in 1986. Stock abundance increased steadily during the 1970s, but has declined in recent years, while fishing mortality has been above the level conducive to long-term stability in three of the past five years. The stock is now considered to be in a fully exploited state;

Atlantic cod landings have declined sharply from 18,000 tons in 1983 to 10,000 tons in 1986. Fishing effort in 1986 increased to record-high levels while commercial catch rates declined to record low levels implying that fishing mortality in 1986 increased substantially.
Continued fishing at the 1986 level will result in further declines in stock biomass and landings;

American lobster landings from near-shore locations have remained at record levels in recent years, averaging about 18,000 tons in 1985 and 1986. Declining abundance in the offshore areas and high fishing mortality rates in coastal locations remain a source of serious concern;

Silver hake landings have increased substantially in recent years, although current landings are well below historic levels. Although stock abundance remains well below previous levels, the stock is considered to be underexploited, given the low recent catches;

American plaice landings doubled between 1977 and 1980 from 7,000 tons to 14,000 tons, but have since declined to 4,500 tons in 1986. Stock abundance increased briefly during the mid-1970s, but has declined sharply since 1980 to its lowest level since the mid-1970s. Fishing mortality is currently too high to sustain annual landings at their present level;

Witch flounder landings increased from 1,900 tons in 1976 to 6,500 tons in 1984, the highest ever, but declined to 4,500 tons in 1986. Stock abundance increased sharply in 1977 and 1978, but has since declined to levels below the long-term average. Declining abundance trends, coupled with continued high landings, suggest that this resource is being adversely affected at current levels of exploitation;

Redfish landings have declined from about 20,000 tons in the early 1970s to less than 3,000 tons in 1986. Abundance has been steadily declining since the late 1960s and current stock biomass is at approximately one-tenth the level of the late 1960s;

Northern shrimp catches have increased sharply in recent years from 1,000 tons in 1981 to 4,700 tons in 1986. Stock abundance has also increased substantially with the recruitment of the 1982 year class. Current exploitation rates are relatively low; and

Cusk, white hake, and wolffish landings have increased steadily since the late 1970s, and stock abundance of each species has declined slightly. These species are generally landed incidental to other species in the directed fisheries and appear to be fully exploited at present.

Many of the concerns I have just identified have been or will be addressed in amendments to the implementing regulations to the various Magnuson Act fishery management plans for these species.

Present Environmental Quality

A comprehensive evaluation of the status of chemical contamination in sediments of the Gulf of Maine was conducted by the Bigelow Laboratory for Ocean Sciences. The Gulf of Maine and Casco and Penobscot Bays were sampled for polynuclear aromatic hydrocarbons

(PAHs), polychlorinated biphenyls (PCBs), and trace metals in sediments. Thirteen of the 16 PAH compounds designated by the U.S. Environmental Protection Agency (EPA) as "priority" were found in the Gulf. Concentrations of these materials in deep water surficial sediments were at least an order of magnitude lower than were observed in coastal regions. The basins of the Gulf are depositional areas for fine-grained particles and for organic carbon. Although the Wilkinson and Jordan Basins appear to be areas of PAH accumulation, PAHs are not accumulating in Georges Basin. Atmospheric transport is probably the principal mechanism through which PAHs are introduced to the Gulf.

Detectable PCB levels were found in all the sediment samples examined. Stations with highest PCB levels were in the western Gulf, closest to the industrialized regions of New England. The levels found were comparable to those encountered in the New York Bight and Long Island Sound. As is usually so, PCB concentrations were highly correlated with total organic carbon and fine-grained sediments. PCB concentrations are strongly correlated with depth in Jordan and Georges Basins, indicating that these basins are depositional areas for this pollutant. No significant correlation between depth and PCB concentration was found for Wilkinson Basin, which is located in the western Gulf.

Trace metals and PCBs were found in Casco Bay. However, in Penobscot Bay only trace metals were detected in elevated concentrations. PAHs were found in both Casco and Penobscot Bays; in Penobscot Bay they were found in high concentrations, particularly at the head of the estuary.

These findings are generally consistent with more recent assessments by NOAA. Since 1984, NOAA has sampled, through its National Status and Trends Program, a number of sites in the Gulf of Maine to determine levels of toxic chemicals and heavy metals in selected bottom-feeding fish, shellfish, and associated sediments. Annual samples of fish and sediments have been taken through the Benthic Surveillance Project at sites in Machias Bay, Frenchmans Bay, Penobscot Bay, and Casco Bay, off the coast of Maine, and at sites at the mouth of the Merrimac River and in Salem and Boston Harbors. Annual samples of mussels and sediments have been taken in 1986 and 1987 at two additional NOAA Mussel Watch sites in Penobscot Bay, one at Cape Ann, and four in Boston Harbor.

Based on 1984 benthic surveillance data only, the sediments of Boston Harbor and Salem Harbor contained the highest concentrations of PCBs and PAHs of the 50 sites sampled nationally. Both harbors also ranked in the top five sites across the nation for DDT contamination. Boston Harbor sediments were ranked among the top five sites for concentrations of cadmium, chromium, and lead in sediments. While no other sites that NOAA sampled in the Gulf of Maine area showed concentrations approaching those found in Boston and Salem Harbors, Casco Bay contains sediment concentrations of PAHs and DDTs that were well above typical values. Casco Bay also had the highest concentration nationally of any site for lead in fish liver tissue, with Boston Harbor and the mouth of the Merrimac River also showing elevated levels. Casco Bay and the mouth of the Merrimac River also had the third and fourth highest concentrations, respectively, of silver in benthic fish livers. Sufficient data do not exist to determine the long-term trends in concentrations of pollutants in these areas or the effects of these concentrations of pollutants on fish populations over time.

In addition to data from the NOAA National Status and Trends Program, other data are available to evaluate environmental conditions in and around the Gulf of Maine area. For example, data from the "1985 National Shellfish Register of Classified Estuarine Waters," compiled by NOAA and the Food and Drug Administration, show that almost 113,000 acres, or about 15 percent of shellfish growing waters in estuaries bordering the Gulf of Maine, have some limitations placed on harvests. These limitations represent a significant economic loss to the commercial and recreational fishing interests of the region.

The important role that estuaries play in sustaining health and abundance of marine fishes, shellfish, and other animals has been recognized for a long time. However, only recently has attention been focused on the total mix of multiple goods and services that these areas provide. To provide decisionmakers a consistent, uniform information base with which to evaluate conditions across major estuaries, NOAA has been constructing since 1984 a National Estuarine Inventory of the 100 most important estuaries of the continental U.S., including 13 estuaries from Passamaquoddy Bay to Cape Cod. Two major NOAA data atlases of characteristics of these estuaries have already been published: one on physical and hydrologic characteristics in 1985, and one on land use characteristics in 1986. Both are available from NOAA's Office of Oceanography and Marine Assessment.

NOAA is developing an Estuarine and Coastal Ocean Science Framework. This Framework will provide guidance for NOAA's resources in addressing the priority issues of our estuaries and coastal oceans. NOAA's goal in this effort is to understand and predict natural ecosystem processes to assess the effects of human activities on estuarine and coastal resources. The four areas of concern addressed in the Framework are: alterations in freshwater inflow and circulation; toxics, nutrients, and pathogens; habitat loss and degradation; and decline in living resources. This Framework will be the basis for implementing studies in important estuaries such as the Gulf of Maine. The Framework is available from NOAA's Estuarine Programs Office.

In addition to our more general programs, NOAA has specific habitat interests in the Gulf of Maine. The agency is addressing concerns regarding the potential impact of offshore projects on the resources of the Gulf. A proposal to harness tidal energy near Halfmoon Cove would require the construction of dam-like structures. These structures create energy by releasing the tide through turbines with blades. NOAA is principally concerned about the potential mortality rate for river herring and other anadromous fish swimming through these turbines to reach the Gulf of Maine.

In 1985, EPA began a "Near Coastal Waters Initiative" to explore improved methods to manage estuaries and near coastal waters. I am pleased to report that NOAA and EPA have formed a joint team of scientists, engineers, and analysts that is developing a series of information products which will define a consistent set of spatial units for the organization of information about estuaries and the assessment of nearshore waters, to identify nationally significant estuaries, and to develop improved methods to assess problems within and across estuaries. Several documents have already been produced and a synthesis of estuarine and coastal information for EPA Region 1, covering 17 estuaries from Passamaquoddy Bay through Long Island Sound, is underway and will be finished this fall. Using existing NOAA data bases, this prototype assessment will contain information on: 1) physical and hydrologic characteristics; 2) land use and population; 3) nutrient discharges from point, nonpoint, and upstream sources; 4) toxic materials discharges and hazardous waste disposal areas; 5) classified shellfish growing waters; 6) wetlands types and distribution; and 7) public outdoor recreational facilities. Formation of this joint NOAA-EPA team signals an increased commitment by both agencies to address cooperatively environmental quality problems in estuarine and near coastal waters.

Other NOAA Scientific Activities in the Gulf of Maine

NOAA and its predecessor agencies have conducted surveys and research in the Gulf of Maine since 1807 when Thomas Jefferson established the Survey of the Coast. The Survey was responsible for measuring coastal elevations, recording depths and currents, and charting the coast. In the 19th century, the Survey and its successor agencies developed accurate bottom profiles of the Gulf of Maine and the Georges Bank.

The world's first major fisheries research laboratory was established in 1885 at Woods Hole, Massachusetts. NOAA's Northeast Fisheries Center, which is located at Woods Hole, conducts research on the fisheries of New England. For fiscal year 1988, the President's budget requests funding for the operation of the scientific research vessel, the Delaware II, for a limited number of days of fisheries research in the Gulf of Maine.

NOAA's National Sea Grant College Program has sponsored studies that have added to the scientific knowledge of the Gulf of Maine. The Woods Hole Oceanographic Institution Sea Grant Program, the Massachusetts Institute of Technology Sea Grant Program, and the Maine-New Hampshire Sea Grant Program, which in the past have received funding from the NOAA program, have all conducted fruitful research in the Gulf of Maine.

The NOAA National Sea Grant College Program was intended to create a network of colleges and universities with strong programs in marine research and education. The goal has been realized and it is now appropriate for these college and university programs to be fully supported by other Federal research programs (such as those conducted by the National Science Foundation, the Department of the Interior, and the Department of Defense), by non-Federal government programs (such as those conducted by State governments), and by contributions from private sources. Consequently, the President's budget request proposes the termination of NOAA's Sea Grant funding in FY 1988.

Other Federal programs and the activities of scientific coalitions will continue without NOAA Sea Grant funding.

Mr. Chairman, this concludes my written testimony. I would be happy to answer any questions you or other members of the Subcommittee may have.

STATEMENT OF WALTER ANDERSON

To: George Mitchell, Chairman
Senate Subcommittee on Environmental Protection

MARINE RESEARCH BY THE MAINE GEOLOGICAL SURVEY

The Marine Geology Division of the Maine Geological Survey has conducted research for the past five years on geological processes and the geological history of the Gulf of Maine. Much of this work has been in cooperation with investigators from the University of Maine at Orono and all of the work has been federally funded.

Under contract from the U.S. Nuclear Regulatory Commission, the Maine Geological Survey has collected thousands of kilometers of sesimic reflection profiles from Maine's estuaries to evaluate evidence for paleoseismicity (faulting) in the recent geological past. While numerous indications of seafloor instablilty have been recognized (i.e. submarine slumps), no faults have been discerned. Through this work, a considerable body of data bearing on the glacial and modern history of Maine's estuaries has been generated.

Under a similar contract from the Nuclear Regulatory Commission, the Maine Geological Survey has worked with the Institute for Quaternary Studies at the University of Maine at Orono to evaluate the history of sea level change in the Gulf of

Maine. This has involved dating the timing of periods of marine submergence as well as evaluating the contemporary rate of sea level rise.

Through funding from NOAA (Sea Grant), individuals from the Maine Geological Survey and the Geology Department at the University of Maine at Orono have evaluated the bluff erosion rates along portions of Maine's soft coast and related bluff erosion to the formation and maintenance of important coastal environments like salt marshes and mud flats. Additionally sediment budgets have been constructed for Casco Bay, Machias Bay, and the Damariscotta River estuary.

With support from the Coastal Zone Management (CZM) Division of NOAA, the Maine Geological Survey has prepared geological and hazard maps for Maine's large sand beaches and dunes. These maps will be used by the State Department of Environmental Protection to make decisions affecting all development along Maine's beaches.

Under contract to the Department of the Interior (Minerals Management Service), the Maine Geological Survey has prepared maps of Maine's inner continental shelf from New Hampshire to Penobscot Bay. The maps are based on side scan sonar imagery, bottom samples, and submersible dives along the shelf. The maps divide the inner shelf into six geological environments and describe the properties and processes active in those environments. These maps have significant bearing on fisheries research since organisms are influenced by sea floor habitats. Additionally, the side scan images often show the large-scale impact of fishing gear on the bottom.

The diversity of our research has led to a better understanding of how natural geological processes affect those working in the Gulf of Maine and living on the coast. The Maine Geological Survey's research has begun to form a broad base from which future studies of offshore and nearshore environments can be conducted.